Atlantic Fleet Training and Testing Final Environmental Impact Statement/ Overseas Environmental Impact Statement

Volume III

United States Department of the Navy

September 2018

NAVY

Atlantic Fleet Training and Testing
Final Environmental Impact Statement/
Overseas Environmental Impact Statement
Volume III

United States Department of the Navy
September 2018

NAVY

Final
Environmental Impact Statement/Overseas Environmental Impact Statement
Atlantic Fleet Training and Testing

TABLE OF CONTENTS

List of Figures

List of Tables

This page intentionally left blank.

3.8 Reptiles

REPTILES SYNOPSIS

The United States Department of the Navy (Navy) considered all potential stressors that reptiles could potentially be exposed to from the Proposed Action. The following conclusions have been reached for the Preferred Alternative (Alternative 1):

- Acoustic: Navy training and testing activities have the potential to expose reptiles to multiple types of acoustic stressors, including sonars, other transducers, air guns, pile driving, and vessel, aircraft, and weapons noise. Reptiles could be affected by only a limited portion of acoustic stressors because reptiles have limited hearing abilities. Exposures to sound-producing activities present risks that could range from hearing loss, auditory masking, physiological stress, and changes in behavior; however, no injurious impacts are predicted due to exposure to any acoustic stressor. Because the number of sea turtles potentially impacted by sound-producing activities is small, population-level effects are unlikely. Few, if any impacts on crocodilians or terrapins are anticipated from acoustic stressors because of the location of training activities relative to crocodilian and terrapin habitats.
- Explosive: Explosions in the water or near the water's surface present a risk to reptiles located in close proximity to the explosion, because the shock waves produced by explosives could cause injury or result in the death. If further away from the explosion, impulsive, broadband sounds introduced into the marine environment may cause hearing loss, auditory masking, physiological stress, or changes in behavior. Sea turtles would be exposed to explosive stressors in the nearshore and offshore portions of the Study Area, while crocodilians and terrapins would be exposed to explosive stressors at two inshore training and testing locations. One loggerhead sea turtle mortality is predicted. Because the number of sea turtles potentially impacted by explosives is small, population-level effects are unlikely. It is unlikely that crocodilians and terrapins would be in close proximity to inshore explosions because they would likely, if present, flee the area in response to other stressors (e.g., vessel noise, visual stimulus). Also, the types of explosives are small limpet mine charges, which limits the area where crocodilians and terrapins could be exposed to injurious impacts from explosives. Because inshore explosives training activities would impact few, if any, crocodilians or terrapins, population-level effects are unlikely.
- Energy: Navy training and testing activities have the potential to expose reptiles to multiple energy stressors in offshore and inshore training and testing locations. The likelihood and magnitude of energy impacts depends on the proximity of a reptile to energy stressors. Based on the relatively weak strength of the electromagnetic field created by Navy activities, impacts on sea turtle migrating behaviors and navigational patterns are not anticipated. Potential impacts from high-energy lasers would only result for sea turtles directly struck by the laser beam. Statistical probability analyses demonstrate with a high level of certainty that no sea turtles would be struck by a high-energy laser. Activities that generate

Continued on the next page…

Continued from the previous page…

REPTILES SYNOPSIS

electromagnetic fields would occur in inshore habitats potentially inhabited by crocodilians and terrapins; however, no measureable impacts on individuals would be expected to occur. Activities using high-energy lasers would not occur in inshore training and testing locations. Energy stressors associated with Navy training and testing activities are temporary and localized in nature, and based on patchy distribution of reptiles, impacts on individual reptiles are unlikely and no impacts on populations are anticipated.

- Physical Disturbance and Strike: Vessels, in-water devices, and seafloor devices present a risk for collision with sea turtles, particularly in coastal areas where densities are higher. Strike potential by expended materials is statistically small. Because of the low numbers of sea turtles potentially impacted by activities that may potentially cause a physical disturbance and strike, population-level effects are unlikely. Activities that use vessels, in-water devices, and seafloor devices would occur in habitats used by crocodilians and terrapins. Activities that expend materials would also occur in inshore habitats inhabited by crocodilians and terrapins; however, interactions with materials would not likely occur, and no impacts on individual crocodilians and terrapins are expected if a reptile encountered expended material. Because of the low numbers of crocodilians and terrapins potentially impacted by activities that may potentially cause a physical disturbance and strike, population-level effects are unlikely.
- Entanglement: Sea turtles could be exposed to multiple entanglement stressors in inshore and offshore training and testing locations. The potential for impacts is dependent on the physical properties of the expended materials and the likelihood that a sea turtle would encounter a potential entanglement stressor and then become entangled in it. Physical characteristics of wires and cables, decelerators/parachutes, and biodegradable polymers combined with the sparse distribution of these items throughout the Study Area indicates a very low potential for sea turtles to encounter and become entangled in them. Long-term impacts on individual sea turtles and sea turtle populations from entanglement stressors associated with Navy training and testing activities are not anticipated. Entanglement stressors are not anticipated to impact crocodilians or terrapins because activities that expend materials that present a potential entanglement risk would not co-occur with crocodilian or terrapin habitats.
- Ingestion: Navy training and testing activities have the potential to expose reptiles to multiple ingestion stressors and associated impacts in inshore and offshore training and testing locations. The likelihood and magnitude of impacts depends on the physical properties of the military expended items and the feeding behaviors of the particular species of reptiles that occur in specific areas where potentially ingestible items are used. Adverse impacts from ingestion of military expended materials would be limited to the unlikely event

Continued on the next page…

Continued from the previous page…

REPTILES SYNOPSIS

that a sea turtle, crocodilian, or terrapin would be harmed by ingesting an item that becomes embedded in tissue or is too large to be passed through the digestive system. The likelihood that a reptile would encounter and subsequently ingest a military expended item associated with Navy training and testing activities is considered low. Long-term consequences to reptile populations from ingestion stressors associated with Navy training and testing activities are not anticipated.

- Secondary: Reptiles could be exposed to multiple secondary stressors (indirect stressors to habitat or prey) associated with Navy training and testing activities in the Study Area. In-water explosions have the potential to injure or kill prey species that sea turtles feed on within a small area affected by the blast; however, impacts would not substantially impact prey availability for sea turtles, crocodilians, or terrapins. Explosion byproducts and unexploded munitions would have no meaningful effect on water or sediment quality; therefore, they are not considered to be secondary stressors for reptiles. Metals are introduced into the water and sediments from multiple types of military expended materials. Available research indicates metal contamination is very localized and that bioaccumulation resulting from munitions would not occur. Several Navy training and testing activities introduce chemicals into offshore and inshore environments that are potentially harmful in concentration; however, through rapid dilution, toxic concentrations are unlikely to be encountered by sea turtles, crocodilians, or terrapins. Furthermore, bioconcentration or bioaccumulation of chemicals introduced by Navy activities to levels that would significantly alter water quality and degrade sea turtle habitat has not been documented. Secondary stressors from Navy training and testing activities in the Study Area are not expected to have long-term impacts on sea turtle populations. Secondary stressors discussed above would overlap with crocodilian and terrapin habitats at inshore training locations. As with sea turtles, toxic concentrations of chemicals and munitions constituents are unlikely to be encountered by crocodilians and terrapins; therefore, bioconcentration or bioaccumulation of chemicals introduced by Navy activities would not likely alter water quality, degrade habitats, or reduce prey availability. Any indirect stressors to habitat or prey from training and testing activities are anticipated to be negligible, and no population-level impacts are anticipated.

3.8.1 Introduction

This section provides a brief introduction to reptiles that occur within the boundaries of the Study Area and whose distribution may overlap with stressors associated with the Proposed Action. The National Marine Fisheries Service (NMFS) and the United States Fish and Wildlife Service (USFWS) share jurisdictional responsibility for sea turtles under the Endangered Species Act (ESA). USFWS has responsibility in the terrestrial environment (e.g., nesting beaches), while NMFS has responsibility in the marine environment. Jurisdictional management of the crocodilian species included in this analysis is the responsibility of the USFWS.

Sea turtles considered in this analysis are found in coastal waters and on nesting beaches of the United States (U.S.) Atlantic Coast, Gulf of Mexico, Caribbean Sea, and in open ocean areas.[1] These species include green sea turtles (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), Kemp's ridley turtle (*Lepidochelys kempii*), leatherback turtle (*Dermochelys coriacea*), and loggerhead turtle (*Caretta caretta*). The American crocodile (*Crocodylus acutus*) and American alligator (*Alligator mississippiensis*) belong to group of reptiles called crocodilians. The American crocodile inhabits coastal areas of south Florida where they are at the northern extreme of their range. American alligators range throughout the southeastern U.S., in estuaries and freshwater habitats along rivers and lakes. The diamondback terrapin (*Malaclemys terrapin*) is also found in nearshore and inshore waters along the Atlantic and Gulf coasts. All of the sea turtles analyzed in this document are ESA listed, along with the American crocodile. The American alligator is listed under the ESA classification of "threatened due to similarity of appearance" to the American crocodile. The diamondback terrapin is not ESA listed. Each species is discussed further in Section 3.8.2 (Affected Environment).

3.8.2 AFFECTED ENVIRONMENT

3.8.2.1 General Background

All reptiles are ectotherms, commonly referred to as "cold-blooded" animals that have adopted different strategies to use external sources of heat to regulate body temperature. Within the Atlantic Fleet Training and Testing (AFTT) Study Area, sea turtles, crocodilians, and diamondback terrapins are analyzed for potential impacts.

Sea turtles are highly migratory, long-lived reptiles that occur throughout the open-ocean and coastal regions of the Study Area. Generally, sea turtles are distributed throughout tropical to subtropical latitudes, with some species extending into temperate seasonal foraging grounds. In general, sea turtles spend most of their time at sea, with female turtles returning to land to nest. Habitat and distribution vary depending on species and life stages, and is discussed further in the species profiles and summarized in the following sections.

Crocodilians are also long-lived reptiles whose life spans can exceed 40 years in the wild. Crocodilians control their body temperature by basking in the sun or moving to areas with warmer or cooler air and water temperatures. The American crocodile inhabits freshwater wetland habitats, including rivers, lakes, and reservoirs, and can also be found in brackish environments such as estuaries and swamps (Fishman et al., 2009). It occurs within the Study Area in coastal portions of the Caribbean and in Florida. The alligator is found throughout the southeastern United States, from the Carolinas to Texas. Unlike American crocodiles, American alligators lack lingual salt glands and are therefore unable to remove excess salt from their bodies (Nifong & Silliman, 2017). Gardner et al. (2016) predictively modeled alligator occurrence in North Carolina and found a strong negative relationship between water salinity

[1] The olive ridley sea turtle (*Lepidochelys olivacea*) was considered for inclusion in this document, but because its occurrence in the Study Area is extralimital (outside the species' normal range), the species will not be analyzed. Western Atlantic olive ridley sea turtle populations are centered near Suriname/French Guiana and Brazil. Occurrences as far north as Puerto Rico, the Dominican Republic, and Cuba are considered rare. Between 1999 and 2001, three individuals were reported in coastal south Florida; however, all were strandings (Foley et al., 2003). Currently, there are no olive ridley nesting beaches in the eastern United States, and there are no known feeding, breeding, or migration areas within the Study Area; therefore, there does not appear to be a nexus between olive ridley sea turtles and Navy training and testing activities.

and alligator occurrence and abundance. Throughout their range, American alligators are usually found in freshwater wetland habitats, in slow-moving rivers, or in the brackish waters of swamps, marshes, and lakes. Neither species occurs in offshore oceanic waters.

Diamondback terrapins can be found along the eastern and gulf coasts of the United States, from Cape Cod (Massachusetts) to Texas. They are most common in salt marshes and shallow bays. They are usually found in brackish water and occasionally travel out into the open ocean. However, they cannot tolerate full-strength salty water for long periods of time, or they may dehydrate.

Additional species profiles and information on the biology, life history, species distribution, and conservation of reptile species can also be found on the following organizations:

- NMFS Office of Protected Resources (includes sea turtle species distribution maps),
- USFWS Ecological Services Field Office and Region Offices (for sea turtle nesting habitat and general locations of nesting beaches),
- Ocean Biogeographic Information System-Spatial Ecological Analysis of Megavertebrate Populations (known as OBIS-SEAMAP) species profiles,
- International Union for Conservation of Nature, Marine Turtle Specialist Group, and
- State resource agencies (for sea turtle nesting information, status and management for American alligators and diamondback terrapins).

Detailed information about threats to these species and life history information can be found in the ESA listing documentation and their recovery plans (Federal Register 44 (244): 75074–75076, December 18, 1979; Federal Register 52 (107): 21059–21064, June 4, 1987; Federal Register 72 (53): 13027–13040, March 20, 2007).

3.8.2.1.1 Group Size

Sea turtles are generally solitary animals, but they tend to group during migrations and mating. Because they do not show territoriality, foraging areas often overlap. New hatchlings, which often emerge from nesting beaches in groups, are solitary until they are sexually mature (Bolten, 2003b; Bowen et al., 2004; James et al., 2005a; Schroeder et al., 2003).

Crocodiles and alligators are territorial, but will gather in groups as juveniles (as a defense against predators), and as adults when exhibiting courtship behavior and feeding (Hidalgo-Ruz et al., 2012; National Park Service, 2012). For both American crocodiles and American alligators, courtship and mating take place during the spring warming period (typically April and May), and nesting and egg-laying is initiated during the early part of the warm, wet summers (Briggs-Gonzalez et al., 2017; Vliet, 2001).

Diamondback terrapins may hibernate individually or hibernate together in large groups (Sheridan et al., 2010). Pfau and Roosenburg (2010) used harvesting records in the Chesapeake Bay to estimate that large hibernating groups may number as many as 200 individual diamondback terrapins.

3.8.2.1.2 Habitat Use

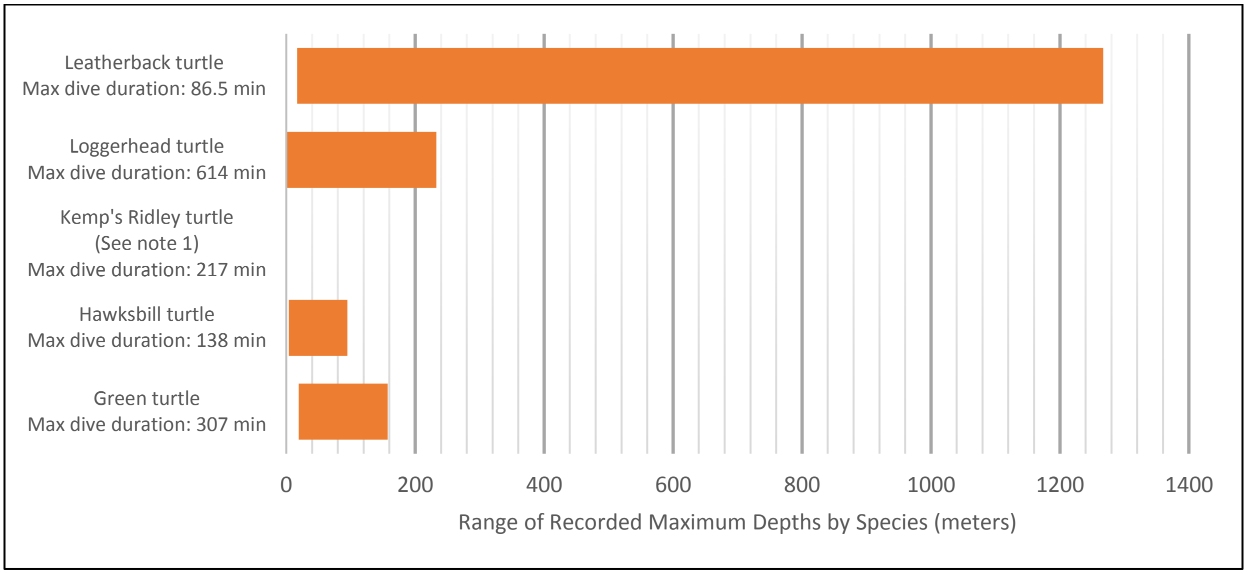
Sea turtles are dependent on beaches for nesting habitat, in locations that have sand deposits that are not inundated with tides or storm events prior to hatching. In the water, sea turtle habitat use is dependent on species and corresponds to dive behavior because of foraging and migration strategies, as well as behavior state (e.g., diving deep at night for resting purposes) (Hart et al., 2016).

Crocodiles and alligators depend on brackish and fresh water estuarine wetland types, where there is sufficient water to use as concealment for hunting and stalking of prey. Nesting habitats are on dry land, with eggs deposited in holes dug in soft mud and sediments (Britton, 2009).

Although diamondback terrapins are an aquatic turtle and spend the majority of their life in water, they do leave the water to bask and lay eggs. One biological advantage these turtles have acquired over time is the ability to survive in salt waters of variable salinities (Pfau & Roosenburg, 2010).

3.8.2.1.3 Dive Behavior

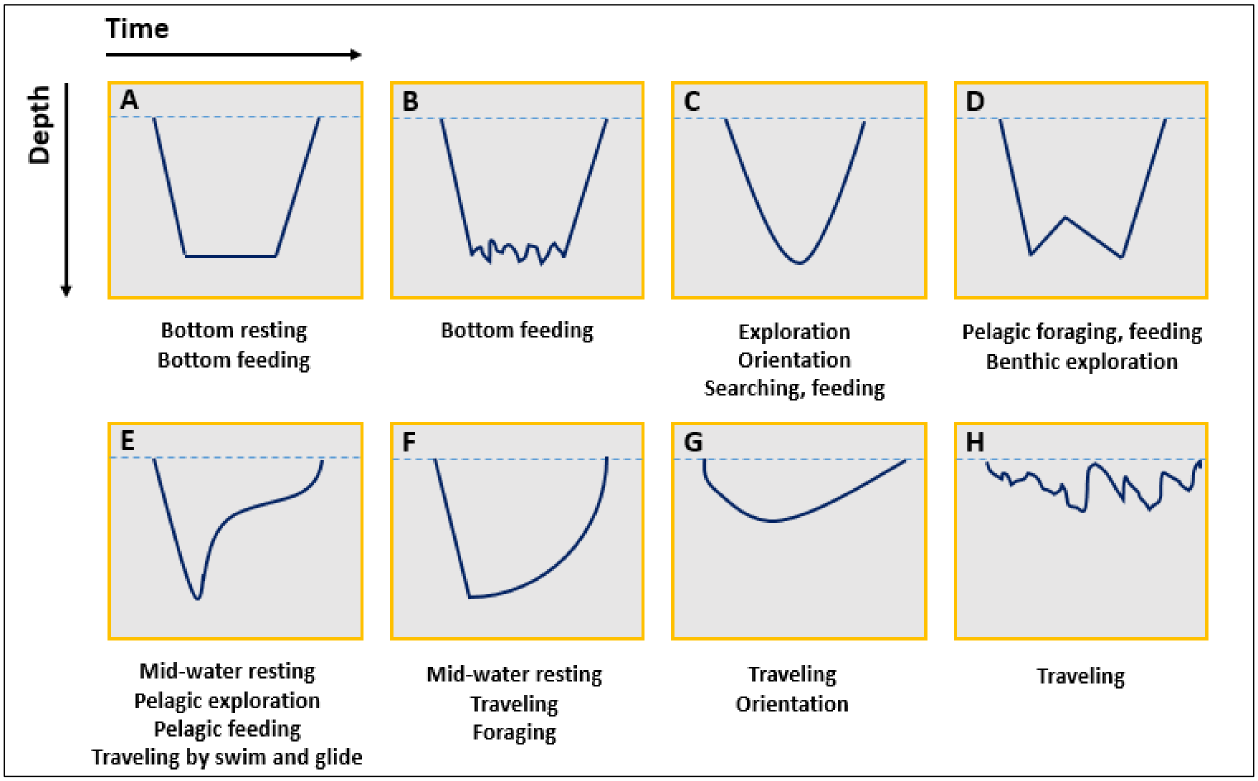
While the American crocodile, American alligator, and diamondback terrapin do submerge, they do not dive in the traditional sense; thus these species are not discussed in this section. Sea turtle dive depth and duration varies by species, the age of the animal, the location of the animal, and the activity (e.g., foraging, resting, and migrating). Dive durations are often a function of turtle size, with larger turtles being capable of diving to greater depths and for longer periods. The diving behavior of a particular species or individual has implications for mitigation, monitoring, and developing sound conservation strategies. In addition, their relative distribution through the water column is an important consideration when conducting acoustic exposure analyses. Methods of collecting dive behavior data over the years has varied in study design, configuration of electronic tags, parameters collected in the field, and data analyses. Collected data from 57 studies were published between 1986 and 2013, which summarized depths and durations of dives of datasets including an overall total of 538 sea turtles. Figure 3.8-1 presents the ranges of maximum dive depths for each sea turtle species found in the Study Area.



Sources: Hochscheid (2014); Sakamoto et al. (1993); (Rice & Balazs, 2008) ; Gitschlag (1996); Salmon et al. (2004)
Note: This figure shows the ranges of maximum dive depths and durations reported in the literature for the sea turtle species included in this analysis. Only one study was reviewed for Kemp's ridley turtle, which recorded depths of one juvenile Kemp's ridley turtle, and was not comparable to other data collected on other species.

Figure 3.8-1: Dive Depth and Duration Summaries for Sea Turtle Species

Hochscheid (2014) also collected information on generalized dive profiles, with correlations to specific activities, such as bottom resting, bottom feeding, orientation and exploration, pelagic foraging and feeding, mid-water resting, and traveling during migrations. Generalized dive profiles compiled from 11 different studies by Hochscheid (2014) show eight distinct profiles tied to specific activities. These profiles and activities are shown in Figure 3.8-2.



Sources: Hochscheid (2014); Rice and Balazs (2008), Sakamoto et al. (1993), Houghton et al. (2003), Fossette et al. (2007), Salmon et al. (2004), Hays et al. (2004); Southwood et al. (1999)

Note: Profiles A-H, as reported in the literature and compiled by Hochscheid (2014). The depth and time arrows indicate the axis variables, but the figure does not represent true proportions of depths and durations for the various profiles. In other words, the depths can vary greatly, but behavioral activity seems to dictate the shape of the profile. Profiles G and H have only been described for shallow dives (less than 5 m).

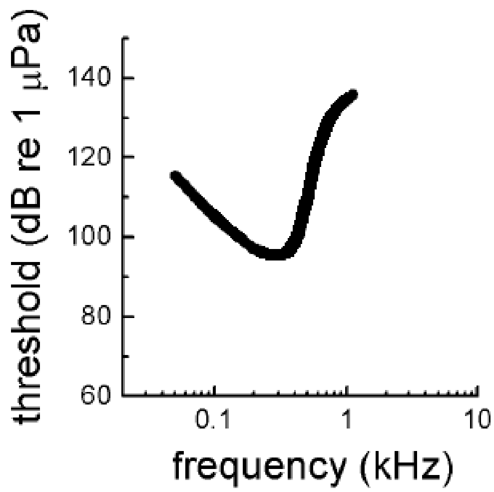
Figure 3.8-2: Generalized Dive Profiles and Activities Described for Sea Turtles

3.8.2.1.4 Hearing and Vocalization

3.8.2.1.4.1 Sea Turtles

Sea turtle ears are adapted for hearing underwater and in air, with auditory structures that receive sound via bone conduction (Lenhardt et al., 1985), via resonance of the middle ear cavity (Willis et al., 2013), or via standard tympanic middle ear path (Hetherington, 2008). Studies of hearing ability show that sea turtles' ranges of in-water hearing detection generally lie between 50 and 1600 hertz (Hz), with maximum sensitivity between 100 and 400 Hz, and that hearing sensitivity drops off rapidly at higher frequencies. Sea turtles are also limited to low-frequency hearing in-air, with hearing detection in juveniles possible between 50 and 800 Hz, with a maximum hearing sensitivity around 300 to 400 Hz (Bartol & Ketten, 2006; Piniak et al., 2016). Hearing abilities have primarily been studied with sub-adult, juvenile, and hatchling subjects in four sea turtle species, including green (Bartol & Ketten, 2006; Ketten & Moein-Bartol, 2006; Piniak et al., 2016; Ridgway et al., 1969), Kemp's ridley (Bartol & Ketten, 2006), loggerhead (Bartol et al., 1999; Lavender et al., 2014; Martin et al., 2012), and leatherback. Only one study examined the auditory capabilities of an adult sea turtle (Martin et al., 2012); the hearing range of the adult loggerhead turtle was similar to other measurements of juvenile and hatchling sea turtle hearing ranges.

Using existing data on sea turtle hearing sensitivity, the U.S. Department of the Navy (Navy) developed a composite sea turtle audiogram for underwater hearing (Figure 3.8-3), as described in the technical report *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (U.S. Department of the Navy, 2017).



Source: U.S. Department of the Navy (2017)
Notes: dB re 1 μPa: decibels referenced to 1 micropascal; kHz: kilohertz

Figure 3.8-3: Composite Underwater Audiogram for Sea Turtles

The role of underwater hearing in sea turtles is unclear. Sea turtles may use acoustic signals from their environment as guideposts during migration and as cues to identify their natal beaches (Lenhardt et al., 1983). However, they may rely more on other senses, such as vision and magnetic orientation, to interact with their environment (Avens, 2003; Narazaki et al., 2013).

Sea turtles are not known to vocalize underwater. Some sounds have been recorded during nesting activities ashore, including belch-like sounds and sighs (Mrosovsky, 1972), exhale/inhales, gular pumps, and grunts (Cook & Forrest, 2005) by nesting female leatherback turtles and low-frequency pulsed and harmonic sounds by leatherback embryos in eggs and hatchlings (Ferrara et al., 2014).

3.8.2.1.4.2 Crocodilians

Crocodilians (e.g., crocodiles and alligators), like other amphibious species, have both in-air and underwater hearing capabilities. However, crocodilians appear to be structurally adapted for detection of airborne sound based on the similarities between crocodilian and avian ear morphology and the corresponding auditory brainstem structures (Gleich & Manley, 2000). Crocodilians detect airborne sound via the tympanic membrane, while sounds in water appear to be detected via bone conduction (Higgs et al., 2002). Crocodilians have external muscular flaps both above and below the opening of the external auditory canal that reflexively close to seal off the canal when submerged and relax to open above/out of the water (Saunders et al., 2000; Shute & Bellairs, 1955).

The hearing ranges for crocodilians was observed to extend to higher frequencies in air than in water (Higgs et al., 2002). Crocodilians use hearing for prey detection and social communication, but also rely on good vision, scent, and touch for interacting with their environment (Grigg & Gans, 1993; Wever, 1971). With regard to sound production, crocodilian calls are typically low frequency, short, and repetitive. Adult calls include courtship bellows at the air-water interface with a notable in-water component (20–250 Hz); grunts (up to 1 kHz); hisses during threat displays, and coughs (Garrick et al., 1978; Vergne et al., 2009; Vliet, 1989). Hatchling and juvenile American alligators have a more restricted communication repertoire (Higgs et al., 2002). Sound production includes contact calls made when feeding or moving in groups and hisses or snarls when threatened (Bierman et al., 2014).

3.8.2.1.4.3 Terrapins

No definitive research is available to ascertain how terrapins use sound in the environment. Hearing may be used to locate food or mates, avoid predators, navigate, or communicate (Lester, 2013). Lester et al. (2012) determined that diamondback terrapins can hear a limited range of low-frequency tones less than 1,000 Hz. Terrapins responded to in-air sounds from 100 to 1,000 Hz, with the range of best hearing from 400 to 600 Hz with mean lowest threshold of 64 dB re 20 µPa SPL (Lester, 2013). In-water, terrapins responded to sounds from 50 to 800 Hz with mean lowest threshold of 86 dB re 1 µPa SPL (Lester, 2013).

3.8.2.1.5 General Threats

3.8.2.1.5.1 Water Quality

Sea Turtles

Water quality in sea turtle habitats can be affected by a wide range of activities. The potential for energy exploration and extraction activities to degrade nearshore and offshore habitats are discussed in Section 3.8.2.1.5.2 (Commercial Industries). Marine debris in sea turtle habitats is discussed in Section 3.8.2.1.5.6 (Marine Debris). Chemical pollution and impacts on water quality is also of great concern, although its effects on reptiles are just starting to be understood in marine organisms (Law et al., 2014; Ortmann et al., 2012). Oil and other chemical spills are a specific type of ocean contamination that can have damaging effects on some sea turtle and other marine reptile species directly through exposure to oil or chemicals and indirectly due to pollutants' impacts on prey and habitat quality. Ingested plastics, discussed in more detail in Section 3.8.2.1.5.6 (Marine Debris), can also release toxins, such as bisphenol-A (commonly known as "BPA") and phthalates, and organisms may absorb heavy metals from the ocean and release those into tissues (Fukuoka et al., 2016; Teuten et al., 2007). Life stage, geographic location relative to concentrations of pollutants, and feeding preference affects the severity of impacts on sea turtles associated with chemical pollution in the marine environment.

Crocodilians

For the American crocodile, the increase in salinity levels from fresh water input reductions may influence distributions in southern Florida (Mazzotti et al., 2016). One of the goals of the Comprehensive Everglades Restoration Plan is to restore historic freshwater flows through portions of the Everglades. Henry et al. (2016) modeled potential effects of restoring freshwater flows to the Everglades, predicting crocodile populations across south Florida decreasing approximately 3 percent after the restoration of flows compared to future conditions without restoration, but local increases up to 30 percent in the Joe Bay area near Taylor Slough, and local decreases up to 30 percent in the vicinity of Buttonwood Canal.

American alligators are often cited as indicators for water quality, in particular for heavy metal pollution (Brandt et al., 2016; Hodge, 2011). Fluctuations in water levels are a primary driver for alligator presence in inland freshwater systems (Brandt et al., 2016; Hidalgo-Ruz et al., 2012; National Park Service, 2012), along with lower salinities (Gardner et al., 2016; Nifong & Silliman, 2017).

Terrapins

Diamondback terrapins are also considered to be an indicator species for water quality (Pfau & Roosenburg, 2010). Although it is unclear how pollutants in terrapin habitats may impact individual terrapins and populations, studies on terrapins in polluted waters indicate that terrapins uptake pollutants into tissues, and higher abundances of terrapins are found in relatively higher quality waters than polluted waters within the same bay system. For example, Basile et al. (2011) measured fat content in diamondback terrapins for a number of contaminants, including persistent organic pollutants (e.g., polychlorinated biphenyls, polybrominated diphenyl ethers, chlorinated pesticides, and methyl-triclosan). This study was conducted by collecting fat biopsies on terrapins in Barnegat Bay in New Jersey, covering industrial areas and outfalls, as well as less polluted areas of the bay (e.g., Forsythe National Wildlife Refuge). Basile et al. (2011) found that terrapins closer to the industrial area had higher persistent organic pollutants in fat stores than terrapins further from sources of industrial pollution. Male terrapins had higher concentrations of pollutants in fat stores than females, while females had higher concentrations of persistent organic pollutants in plasma than males (Basile et al., 2011).

3.8.2.1.5.2 Commercial Industries

Sea Turtles

In offshore areas of the Study Area, bycatch from commercial fisheries is a primary threat to sea turtles. In U.S. fisheries, Finkbeiner et al. (2011) estimate that bycatch resulted in 71,000 sea turtle deaths per year prior to effective regulations that protect sea turtles (e.g., regulations adopted since the mid-1990s in different U.S. fisheries for turtle exclusion devices). Current mortality estimates are 94 percent lower (4,600 deaths) than pre-regulation estimates (Finkbeiner et al., 2011). One comprehensive study estimates that worldwide, 447,000 sea turtles are killed each year from bycatch in commercial fisheries around the world (Wallace et al., 2010a; Wallace et al., 2010b). Lewison et al. (2014) compared bycatch using three different gear types (longline, gillnet, and trawling nets) for sea turtles, marine mammals, and seabirds. Sea turtles were most susceptible to bycatch, with the Mediterranean and waters off the Atlantic coast of South America as the two highest fisheries reporting sea turtle mortalities (primarily through trawling) (Lewison et al., 2014). Offshore energy development, including oil and natural gas extraction in coastal and deep waters on the continental shelf, as well as renewable energy projects, can degrade habitats during pre-construction and operation phases (Bergström et al., 2014; Finkbeiner et al., 2011; Wright & Kyhn, 2015).

In nearshore areas, large-scale commercial exploitation also contributes to global decline in marine turtle populations. Currently, 42 countries and territories allow direct take of turtles and collectively take in excess of 42,000 turtles per year, the majority of which (greater than 80 percent) are green sea turtles (Humber et al., 2014). Illegal fishing for turtles and nest harvesting also continues to be a major cause of sea turtle mortality, both in countries that allow sea turtle take and in countries that outlaw the practice (Lam et al., 2011; Maison et al., 2010). For example, Humber et al. (2014) estimated that in Mexico, 65,000 sea turtles have been illegally harvested since 2000. The authors, however, noted a downward trend of legal and illegal direct takes of sea turtles over the past three decades—citing a greater than 40 percent decline in green sea turtle take since the 1980s, a greater than 60 percent decline in hawksbill and leatherback take, and a greater than 30 percent decline in loggerhead take (Humber et al., 2014).

Offshore energy development activities have likely led to negative consequences for sea turtle populations within the Study Area. The *Deepwater Horizon* spill in 2010, releasing 200 million gallons of crude oil into the Gulf of Mexico (Putman et al., 2015a), is anticipated to have long-term effects that persist for decades (National Marine Fisheries Service, 2011, 2014a). Prior to drilling operations, vessel traffic and seismic disturbances through exploration activities can degrade sea turtle coastal and open ocean foraging habitats. As of 2017, the global offshore wind industry had a current installed capacity of nearly 18,000 megawatts (Mills, et al. 2018) and is expected to grow to more than 37,000 megawatts by 2020 (Smith et al., 2015). Off of U.S. shores, approximately 20,000 megawatts of installed capacity is planned over the next few years, with most development occurring off the coasts of Massachusetts, New Jersey, Virginia, and North Carolina (Smith et al., 2015). Construction of offshore wind energy facilities in mid-Atlantic is likely to occur in warmer months, and sea turtles will be present during these periods (Williams et al., 2015). Onshore development can lead to nesting habitat loss or habitat degradation. Construction activities can facilitate erosion or inhibit natural sediment deposition to form beaches. Once facilities are operational, artificial lighting, noise, and other stressors can degrade nesting habitats (Seminoff et al., 2015).

Boat strike has been identified as one of the important mortality factors in several nearshore turtle habitats worldwide. Precise data are lacking for sea turtle mortalities directly caused by ship strikes; however, live and dead turtles are often found with deep cuts and fractures indicative of collision with a boat hull or propeller (Hazel et al., 2007; Lutcavage et al., 1997). For example, scientists in Hawaii reported that 2.5 percent of green sea turtles found dead on the beaches between 1982 and 2003 had been killed by boat strike (Chaloupka et al., 2008), and in the Canary Islands, 23 percent of stranded sea turtles showed lesions from boat strikes or fishing gear (Oros et al., 2005). Denkinger et al. (2013) reports that boat strikes in the Galapagos Islands were most frequent at foraging sites close to a commercial and tourism port.

Crocodilians

American crocodiles and American alligators were widely hunted for their skins from 1920 to 1970, which led to significant population declines across all parts of the species range. Country-specific (e.g., the listing of the American crocodile as endangered in 1973 under the ESA) and international trade restrictions, along with the availability of legally obtained skins from other crocodilians, have significantly reduced commercial hunting in recent decades (Brandt et al., 2016; National Park Service, 2012; Thorbjarnarson et al., 2006). Regulated commercial use of captive reared crocodilians has relieved commercial exploitation for wild crocodilians. The American alligator population has expanded greatly throughout its historic range in wetlands of the southeastern United States (Brandt et al., 2016; National Park Service, 2012).

Oil spills that impact freshwater and estuarine habitats will alter important wetland ecological functions, such as removing sediments, nutrients, pesticides, metals, and other pollutants, and provide essential foundations for food chains for wildlife (Corn, 2010), including crocodilians. Oil spills that occur in or wash into these wetlands could reduce prey availability for both the American alligator and the American crocodile. For the American alligator, coastal oil pollution likely has only limited impacts because the highest abundance of alligators are found in inland freshwater systems (Corn, 2010). For American crocodiles, oil spills would have to occur within, or wash into, crocodile habitats in southern Florida for impacts to occur, and would likely be a significant and persistent inhibiting factor in American crocodile recovery.

Habitat destruction (through the filling in of wetlands and altering of hydrologic connectivity, water levels, and salinities) is the primary limiting factor on crocodilian recovery in the United States (Green et al., 2014; Mazzotti et al., 2007; Thorbjarnarson et al., 2006).

Terrapins

Commercial activities that threaten diamondback terrapins include commercial harvesting, bycatch mortality in crab pots, and pollution. Up until the beginning of the 20th century, diamondback terrapins were in great demand by gourmet restaurants in major metropolitan areas of the United States. (Pfau & Roosenburg, 2010). Dredging of shallow water habitats and scraping of hibernacula where terrapins congregate during the winter were the most effective forms of commercial harvesting. Commercial harvesting, as determined by test dredging, tended to capture more females than males, which likely severely reduced the reproductive potential for populations in terrapin fisheries. The commercial demand for terrapins generally subsided through the 20th century. However, there was an increase in terrapin exports to China from the United States in the late 1980s, but by 2007, all of the states within the diamondback terrapin range within the United States had prohibited commercial harvest of terrapins (Pfau & Roosenburg, 2010).

Roosenburg et al. (1997) studied crab pot use in the Chesapeake Bay and estimated that 15–78 percent of the local terrapin population can be captured in crab pots in a single year. Crab pots are designed with small entrances, which tend to capture smaller males rather than larger females. Because of the selective mortality of males in crab pots, Pfau and Roosenburg (2010) estimated that the terrapin sex ratio in the Chesapeake bay at one male to two, possibly three females. New crab traps with terrapin exclusions have greatly reduced terrapin bycatch (Lester, 2013; Pfau & Roosenburg, 2010; University of Georgia, 2017).

Oil spills in coastal areas directly impact diamondback terrapins by oiling and drowning the animals and indirectly by contaminating their nesting beaches (Pfau & Roosenburg, 2010). The short-term impacts of the oil spill from a leak in an underground oil pipeline near Chalk Point, Maryland, showed direct impacts on adult terrapins and decline in hatchling survivability where the oil leak polluted sand in a nesting location (Michel et al., 2001).

Residential and urban development restricts freshwater flow into swamps and estuaries, which may limit diamondback terrapin growth, survival, and abundance, and potentially impact diamondback terrapin habitats if spills reach estuaries and riverine areas (Basile et al., 2011).

3.8.2.1.5.3 Disease and Parasites

Fibropapillomatosis is a disease of sea turtles that results in the production of tumors, both external and internal, that are considered benign, but may obstruct crucial functions, such as swimming, feeding, sight, and buoyancy, and can lead to death (Balazs, 1986; Patrício et al., 2016). The disease was first noticed in 1928, and was not observed again until the 1970s (Day et al., 2016). The disease shows the highest prevalence among green sea turtles (Patrício et al., 2016), with rapid spread of the disease was recorded through the 1980s, becoming an endemic in both Florida and Hawaii in green sea turtle populations (Day et al., 2016; Work & Balazs, 2013). By 1995 the concentration of disease in the population reached its climax and has showed a decline in prevalence since (Patrício et al., 2016).

Edmonds et al. (2016) lists 16 parasites known to occur in sea turtles, with the most common and significant (in terms of impacts on health) being blood flukes and flatworms (Watson et al., 2017). Some of the common external parasites found on sea turtles include leeches and a number of different species that reside on the shell called epibiota (Glandon & Miller, 2016). Leeches are usually seen around where the flippers attach to the rest of the body. Parasitic isopods (e.g., sea lice) can attach themselves to sea turtle soft tissue on the outside and within the mouth (Foster & Gilmour, 2016).

The type and severity of disease in crocodilians and terrapins is poorly understood, and is not considered as a significant threat to species recovery (Florida Fish and Wildlife Conservation Commission, n.d.; Hackney, 2010; National Park Service, 2012; Savannah River Ecology Laboratory & Herpetology Program, 2012).

3.8.2.1.5.4 Invasive Species

Invasive species have been shown to have both harmful and beneficial impacts on sea turtles. Impacts on sea turtles associated with invasive species primarily concern nest predation and prey base. For example, feral hogs (*Sus scrofa*) have been known to destroy several sea turtle nests during a season on certain nesting beaches in Florida (Engeman et al., 2016). Engeman et al. (2016) noted nesting success after a successful implementation of a feral hog control program in Florida. In foraging grounds, sea turtles have been shown to adapt their foraging preferences for invasive seagrass and algae. Becking et al. (2014) showed green sea turtle foraging behavior shift to consumption of *Halophila stipulacea*, a rapidly spreading seagrass in the Caribbean. In Hawaii, green sea turtles in Kaneohe Bay have modified their diets over several decades to include seven non-native species (Spiny Seaweed, *Acanthophora spicifera; Hypnea musciformis, Gracilaria salicornia, Eucheuma denticulatum,* Graceful Red Weed*, Gracilaria tikvahiae;* Agar-agar*, Kappaphycus striatum;* and Elkhorn Sea Moss, *Kappaphycus alvarezii*), with non-native algae accounting for over 60 percent of turtle diet (Russell & Balazs, 2015).

Burmese pythons (*Python bivitattus*) are large generalist predators that have established an expanding breeding population in Florida (Walters et al., 2016). Introduced pythons present a direct threat to the American alligator and American crocodile through predation, where predation of alligators up to 2 m in length have been reported (Dorcas et al., 2012). Introduced pythons were thought to be primarily restricted to freshwater habitats in Florida, but Hart et al. (2012) has shown salt water tolerance in newly-hatched pythons, which may increase the risk for American crocodiles and terrapins. Introduced pythons can also negatively impact crocodilians and terrapins through competition for food. Dorcas et al. (2012) noted severe declines in mammals attributed to python population increases, which remove a small, but significant prey base for alligators and crocodiles.

Draud et al. (2004) and Pfau and Roosenburg (2010) noted that terrapin nests and hatchlings are vulnerable to predation from non-native rats and ants, along with other native terrestrial and avian predators. In addition, invasive vegetation can severely impact wetlands when made vulnerable by high amounts of disturbance. *Phragmites australis*, an invasive emergent marsh reed, is rapidly expanding in coastal wetlands of the United States, particularly brackish wetlands, which likely degrades terrapin nesting areas. Cook (2016) found that *Phragmites australis* can alter vegetation structure, soil temperature, and moisture in nesting locations, which may limit preferred nesting habitats (replacing sparsely vegetated sandy locations with thick stands of *Phragmites australis*), potentially skew sex ratios towards males, and reduce nesting success through the encroachment of root systems into nests.

3.8.2.1.5.5 Climate Change

Sea turtles, crocodilians, and terrapins are particularly susceptible to climate change effects because their life history, physiology, and behavior are extremely sensitive to environmental temperatures (Fuentes et al., 2013; Green et al., 2014; Hart & Lee, 2006; University of Georgia, 2017; Wheatley et al., 2012). Climate change models predict sea level rise and increased intensity of storms and hurricanes in tropical sea turtle nesting areas (Patino-Martinez et al., 2008), as well as coastal areas of the United States where crocodilians and terrapins may nest (Frost et al., 2017). These factors could significantly increase beach inundation and erosion, thus affecting water content of sea turtle, crocodilian, and terrapin nesting beaches and potentially inundating nests (Pike et al., 2015). Climate change may negatively impact reptiles in multiple ways and at all life stages. These impacts may include the potential loss of nesting beaches due to sea level rise and increasingly intense storm surge (Patino-Martinez et al., 2008), feminization of populations from elevated nest temperatures (and skewing populations to more females than males unless nesting shifts to northward cooler beaches) (Reneker & Kamel, 2016) (Pfau & Roosenburg, 2010), decreased reproductive success (Hawkes et al., 2006; Laloë et al., 2016; Pike, 2014), shifts in reproductive periodicity and latitudinal ranges (Pike, 2014), disruption of hatchling dispersal and migration, and indirect effects to food availability (Witt et al., 2010). Erosion, water contaminants, and sea level rise may further increase vulnerability of nesting sites for both the American crocodile and American alligator (Mazzotti et al., 2007; Mazzotti et al., 2016; Savannah River Ecology Laboratory & Herpetology Program, 2012), as well as the diamondback terrapin. Short-term effects on aquatic reptiles and their habitat also include the potential impacts caused by increased hurricane occurrence and intensity (Elsey et al., 2006; Elsey & Woodward, 2010). American alligators are likely less affected by coastal impacts associated with climate change because they occur in freshwater systems further inland (Eversole et al., 2015).

Adaption strategies to protect coastal infrastructure are an anticipated response to rising sea levels. These activities may include shoreline stabilization projects and infrastructure hardening, which could contribute to the loss of nesting habitat. Shoreline stabilization may hold in place beach sediments in a specific location; however, the disruption of onshore currents can reduce the beach replenishment of sediments further away (Boyer et al., 1999; Fish et al., 2008).

3.8.2.1.5.6 Marine Debris

Debris in offshore and inshore waters present ingestion and entanglement risks for sea turtles, crocodilians, and terrapins. Ingestion of marine debris can cause mortality or injury to sea turtles. The United Nations Environment Program estimates that approximately 6.4 million tons of anthropogenic debris enters the marine environment every year (United Nations Environmental Program, 2005). This estimate, however, does not account for cataclysmic events, such as the 2011 Japanese tsunami estimated to have generated 1.5 million tons of floating debris (Murray et al., 2015). Plastic is the primary type of debris found in marine and coastal environments, and plastics are the most common type of marine debris ingested by sea turtles (Schuyler et al., 2014). Sea turtles can mistake debris for prey; one study found 37 percent of dead leatherback turtles to have ingested various types of plastic (Mrosovsky et al., 2009), and Narazaki et al. (2013) noted an observation of a loggerhead exhibiting hunting behavior on approach to a plastic bag, possibly mistaking the bag for a jelly fish. Even small amounts of plastic ingestion can cause an obstruction in a sea turtle’s digestive track and mortality (Balazs et al., 1994; Bjorndal, 1997), and hatchlings are at risk for ingesting small plastic fragments. Ingested plastics can also release toxins, such as bisphenol-A (commonly known as “BPA”) and phthalates, or absorb heavy metals from the ocean and release those into tissues (Fukuoka et al., 2016; Teuten et al., 2007). Life stage and feeding preference affects the likelihood of ingestion. Turtles living in oceanic or coastal environments and feeding in the open ocean or on the seafloor may encounter different types and densities of debris, and may therefore have different probabilities of ingesting debris. In 2014, Schuyler et al. (2014) reviewed 37 studies of debris ingestion by sea turtles, showing that young oceanic sea turtles are more likely to ingest debris (particularly plastic), and that green and loggerhead turtles were significantly more likely to ingest debris than other sea turtle species.

Ribic et al. (2010) documented regional differences in amounts and long-term trends of marine debris (land-based and ocean-based) along the U.S. Atlantic coast, while indexing debris amounts with population growth and fisheries activity. Based on their analysis, Ribic et al. (2010) concluded that the vast majority of marine debris was either land-based (38 percent), general-source debris (42 percent), or ocean-based (20 percent) recreational and commercial sources (Ribic et al., 2010); no items of military origin were differentiated. The inland portions along the southeast Atlantic coast contributed the lowest amounts of debris despite a 19 percent increase in coastal population from 1997 through 2007. The northeast Atlantic coast also contributed low amounts of marine debris, although the coastal population increased by 8 percent. Most of the marine debris inputs along the U.S. Atlantic coast was sourced from inland portions of the mid-Atlantic. With a 10 percent population increase, the types of debris included heavy land-based and general-source debris loads. Where fisheries were stable, ocean-based debris either stayed steady or declined.

Because of the limited overlap of crocodilian habitats and marine debris, marine debris as an entanglement or ingestion hazard for the American crocodile and American alligator is not likely a concern for crocodilian conservation. There is one reported mortality of an estuarine crocodile (*Crocodylus porosus*) in Australia entangled by plastic marine debris (Ceccarelli, 2009); however, Platt and Thorbjarnarson et al. (2006) suggested that accidental drowning in monofilament fishing nets was likely a significant source of mortality for American crocodiles in Belize in conservation areas where poaching is not likely to occur. Outside of conservation areas in Belize, the authors found that poaching was a major cause of crocodile deaths, in addition to drownings in derelict and active fishing nets. Terrapin drowning events are most often associated with bycatch in crab pots (Roosenburg et al., 1997) as well as derelict crab traps (Bilkovic et al., 2014); however, marine debris in estuarine environments likely pose an entanglement hazard for diamondback terrapins.

3.8.2.2 Endangered Species Act-Listed Species

As shown in Table 3.8-1, there are seven species of reptiles listed as Endangered or Threatened under the ESA in the Study Area. Life history descriptions of these species are provided in more detail in the following sections.

Table 3.8-1: Current Regulatory Status and Presence of Endangered Species Act-Listed Reptiles in the Study Area

Species Name and Regulatory Status			Presence in Study Area		
Common Name	**Scientific Name**	**Endangered Species Act Status**	**Open Ocean**	**Large Marine Ecosystem**	**Inshore Waters**
Family Cheloniidae (hard-shelled sea turtles)					
Green Turtle (North Atlantic DPS, South Atlantic DPS)	*Chelonia mydas*	Threatened[1]	North Atlantic Subtropical Gyre, Gulf Stream	Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Caribbean Sea, Gulf of Mexico	Chesapeake Bay, Narragansett Bay, Kings Bay, Port Canaveral, St. Andrew Bay, Corpus Christi Bay
Hawksbill Turtle	*Eretmochelys imbricata*	Endangered[2]	North Atlantic Subtropical Gyre, Gulf Stream	Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Caribbean Sea, Gulf of Mexico	NA
Kemp's Ridley Turtle	*Lepidochelys kempii*	Endangered	North Atlantic Subtropical Gyre, Gulf Stream	Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Gulf of Mexico	Narragansett Bay, Chesapeake Bay, Corpus Christi Bay
Loggerhead Turtle (Northwest Atlantic Ocean DPS)	*Caretta caretta*	Threatened/ Endangered[3]	North Atlantic Subtropical Gyre, Gulf Stream	Newfoundland-Labrador Shelf, Scotian Shelf, Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Caribbean Sea, Gulf of Mexico	Narragansett Bay, Chesapeake Bay, St. Andrew Bay, Kings Bay, Port Canaveral

Table 3.8-1: Current Regulatory Status and Presence of Endangered Species Act-Listed Reptiles in the Study Area (continued)

Species Name and Regulatory Status			Presence in Study Area		
Common Name	**Scientific Name**	**Endangered Species Act Status**	**Open Ocean**	**Large Marine Ecosystem**	**Inshore waters**
Family Dermochelyidae (leatherback sea turtle)					
Leatherback Turtle	*Dermochelys coriacea*	Endangered	North Atlantic Subtropical Gyre, Gulf Stream	Newfoundland-Labrador Shelf, Scotian Shelf, Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Caribbean Sea, Gulf of Mexico	Narragansett Bay, Chesapeake Bay, Port Canaveral
Family Crocodylidae (true crocodiles)					
American Crocodile	*Crocodylus acutus*	Threatened	NA	Southeast U.S. Continental Shelf, Gulf of Mexico	NA
American Alligator	*Alligator mississippiensis*	Threatened due to similarity of appearance[4]	NA	Southeast U.S. Continental Shelf, Gulf of Mexico	Kings Bay, Port Canaveral, St. Andrew Bay, Corpus Christi Bay

[1] On April 6, 2016, the NMFS and USFWS listed the Central West Pacific, Central South Pacific, and Mediterranean distinct population segments as endangered, while listing the other eight distinct population segments (Central North Pacific, East Indian-West Pacific, East Pacific, North Atlantic, North Indian, South Atlantic, Southwest Indian, and Southwest Pacific) as threatened. The AFTT Study Area shares portions of the geographic extents identified for the North Atlantic distinct population segment, including breeding populations along the U.S. Atlantic and Gulf of Mexico coasts.

[2] Hawksbills have been recorded in the Study Area rarely; occurrence in the Northeast U.S. Continental Shelf Large Marine Ecosystem is extralimital (outside of their normal range).

[3] On September 22, 2011, the NMFS and USFWS listed the North Pacific Ocean, South Pacific Ocean, North Indian Ocean, Northeast Atlantic Ocean, and Mediterranean Sea distinct population segments of the loggerhead sea turtle as endangered under the ESA, while the other four distinct population segments (the Southeast Indo-Pacific Ocean, Southwest Indian Ocean, Northwest Atlantic Ocean, and South Atlantic Ocean) are listed as threatened. The AFTT Study Area shares portions of the geographic extents identified for the Northwest Atlantic Ocean distinct population segment.

[4] The American alligator is listed under the Endangered Species Act (ESA) classification of "threatened due to similarity of appearance" to the American crocodile.

Sources: 81 Federal Register 20057, 35 Federal Register 18319, 35 Federal Register 8491, 43 Federal Register 32800, 76 Federal Register 58868

Note: NA = not applicable

3.8.2.2.1 Green Turtle (*Chelonia mydas*)

3.8.2.2.1.1 Status and Management

The green sea turtle was first listed under the ESA in 1978. In 2016, the NMFS and USFWS reclassified the species into 11 "distinct population segments," which maintains federal protections while providing a more tailored approach for managers to address specific threats facing different populations (see the NMFS and USFWS Final Rule published on April 6, 2016). The geographic areas that include these distinct population segments are: (1) North Atlantic Ocean, (2) Mediterranean Sea, (3) South Atlantic Ocean, (4) Southwest Indian Ocean, (5) North Indian Ocean, (6) East Indian Ocean – West Pacific Ocean, (7) Central West Pacific Ocean, (8) Southwest Pacific Ocean, (9) Central South Pacific Ocean, (10) Central North Pacific Ocean, and (11) East Pacific Ocean.

Only the North Atlantic distinct population segment (which was listed as threatened) is within the Study Area and is discussed further in the document. It should be noted, however, that North Atlantic green sea turtle populations have minimal mixing (gene flow) with the South Atlantic regions and no mixing with the Mediterranean region, and juvenile turtles from the North Atlantic may occasionally use south Atlantic or Mediterranean foraging grounds (Seminoff et al., 2015).

Critical habitat is designated within the Study Area (Figure 3.8-4). In 1998, critical habitat was designated for green sea turtles in coastal waters around Culebra Island, Puerto Rico, from the mean high water line seaward to three nautical miles (NM) to include Culebra's outlying Keys (63 *Federal Register* 46693). The essential physical and biological features of this critical habitat include (1) seagrass beds, which provide valuable foraging habitat; (2) coastal waters of Culebra, which serve as a developmental habitat and support juvenile, subadult, and adult green sea turtle populations; and (3) coral reefs and other topographic features that provide shelter (63 *Federal Register* 46693). Puerto Rico's Culebra Island, where the NMFS and USFWS designated Critical Habitat for green sea turtles, supports important habitat for juveniles, subadults, and a small population of adults. Green turtles are most abundant at Culebrita, Mosquito Bay, Puerto Manglar, and Tamarindo Grande, probably due to the presence of dense seagrass beds in those areas (Collazo et al., 1992; Patrício et al., 2016; Patrício et al., 2014). Higher concentrations and abundance in other locations throughout the green sea turtle range also support dense marine vegetation used as foraging grounds (Patrício et al., 2014; Seminoff et al., 2015).

3.8.2.2.1.2 Habitat and Geographic Range

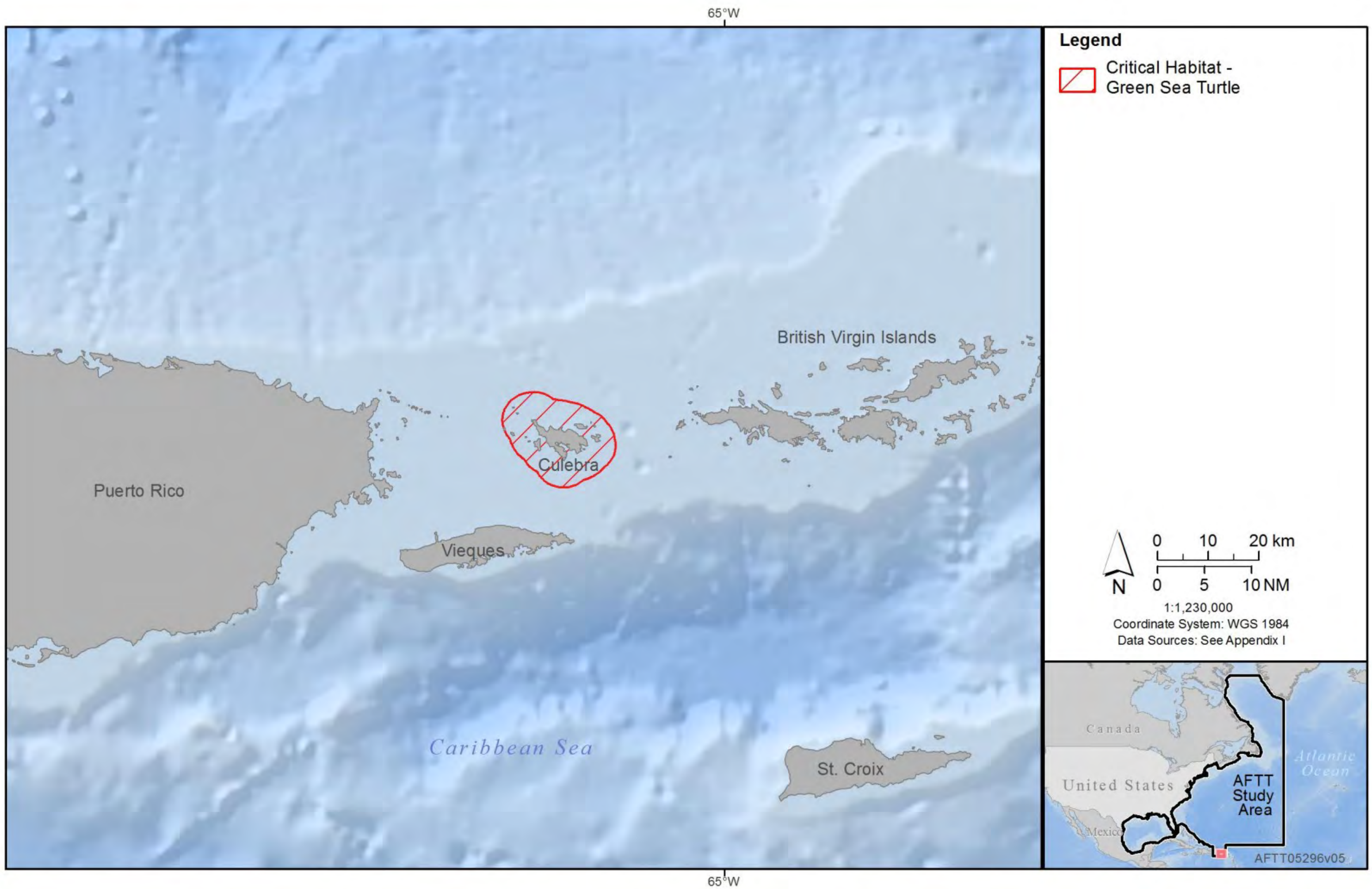
The green sea turtle is distributed worldwide across tropical and subtropical coastal waters generally between 45 degrees (°) north and 40° south. After emerging from the nest, green sea turtle hatchlings swim to offshore areas where they float passively in major current systems; however, laboratory and modeling studies suggest that dispersal trajectories might also be shaped by active swimming (Christiansen et al., 2016; Putman & Mansfield, 2015). Post-hatchling green sea turtles forage and develop in floating *Sargassum* habitats of the open ocean. At the juvenile stage (estimated at five to six years), they leave the open-ocean habitat and retreat to protected lagoons and open coastal areas that are rich in seagrass or marine algae (Bresette et al., 2006), where they will spend most of their lives (Bjorndal & Bolten, 1988). The optimal developmental habitats for late juveniles and foraging habitats for adults are warm shallow waters (3–5 m), with abundant submerged aquatic vegetation and close to nearshore reefs or rocky areas (Holloway-Adkins, 2006; Seminoff et al., 2002; Seminoff et al., 2015). Climate change and ocean warming trends may impact the habitat and range of this species over time (Fuentes et al., 2013). These impacts apply to all sea turtle species and are discussed in Section 3.8.2.1.5.5 (Climate Change).

Four regions within the North Atlantic distinct population segment support nesting concentrations: Costa Rica (Tortuguero), Mexico (Campeche, Yucatan, and Quintana Roo), United States (Florida), and Cuba. The highest concentration of nesting is in Tortuguero, and in Mexico, where nesting occurs primarily along the Yucatan Peninsula. Most green sea turtle nesting occurs in along the Atlantic coast of eastern central Florida, with smaller concentrations along the Gulf coast and Florida Keys. In Cuba, nesting primarily occurs on the extreme western tip of the country and on islands off the southern shore of Cuba. Nesting also occurs in the Bahamas, Belize, Cayman Islands, Dominican Republic, Haiti, Honduras, Jamaica, Nicaragua, Panama, Puerto Rico, Turks and Caicos Islands, North Carolina, South Carolina, Georgia, Texas, and Virginia.

Green sea turtles are known to live in the open-ocean waters of the Gulf Stream and North Atlantic Gyre during the first five to six years of life, but little is known about preferred habitat or general distribution during this life phase beyond the information presented in the introduction to this resource. Although information on migratory routes within this area is limited, recent research has shown that juvenile green sea turtles have the ability to migrate independently of ocean currents (directional and active swimming) to access productive foraging grounds (Christiansen et al., 2016; Putman & Mansfield, 2015; Ribic et al., 2010). The main source of information on distribution in the Study Area comes from U.S. fisheries bycatch. Green turtle post-hatchling and juvenile foraging grounds in the North Atlantic range from coral or nearshore reefs and seagrass beds, to inshore bays and estuaries (Bresette et al., 1998; Plotkin & Amos, 1998). In the western North Atlantic, juvenile green sea turtles forage as far north as Cape Cod Bay, Massachusetts; as far east as Bermuda; and throughout the Caribbean. However, foraging adults are only found from the southernmost reach of the Florida peninsula (Witherington & Hirama, 2006).

As ocean temperatures increase in the spring, green sea turtles migrate from southeastern U.S. waters to the estuarine habitats of Long Island Sound, Peconic Bay, Chesapeake Bay, and possibly Nantucket Sound, where an abundance of algae and eelgrass occurs. Peak occurrence in the Northeast U.S. Continental Shelf Large Marine Ecosystem is likely in September (Berry et al., 2000). During nonbreeding periods, adult and juvenile distributions may overlap in coastal feeding areas (Hirth, 1997; Weishampel et al., 2006).

Juveniles use the estuarine and nearshore waters of central Florida throughout the year, including Pensacola Bay, St. Joseph Bay, Charlotte Harbor, Cedar Keys, Homosassa Springs, Crystal River, and Tampa Bay (Lamont et al., 2015; Langhamer et al., 2016; Renaud et al., 1995; Seminoff et al., 2015). In the northern Gulf of Mexico, green sea turtles prefer the coastal habitats of southern Texas (e.g., lagoons, channels, inlets, bays) where seagrass beds and macroalgae are abundant, including Texas' Laguna Madre (Renaud et al., 1995). As water temperatures rise from April to June, green sea turtle numbers increase in the continental shelf waters of the Gulf of Mexico Large Marine Ecosystem, off Galveston Bay, and in those waters associated with the continental shelf break northeast of Corpus Christi. Green sea turtles found in these deeper waters are likely adults migrating from resident foraging grounds to distant nesting grounds (Meylan, 1995). The sparse sighting records in Louisiana and Texas waters, as well as nesting records on the southern Texas coast, indicate that green sea turtles are found in the northwestern Gulf of Mexico during spring but in far fewer numbers than in the northeastern Gulf.



Note: AFTT: Atlantic Fleet Training and Testing

Figure 3.8-4: Critical Habitat Designated for the Green Sea Turtles in the Study Area

3.8.2.2.1.3 Population Trends

Green turtle nesting has shown an exponential increase over the past 29 years, with nests reported along the Florida panhandle, Florida Gulf coast, Florida Atlantic coast, Georgia, Alabama, South Carolina, North Carolina, and Texas, along with the wider Caribbean, Yucatan Coast of Mexico, Suriname, and Isla Trindade (Brazil) (Florida Fish and Wildlife Conservation Commission, 2017; Seminoff et al., 2015). A green sea turtle nested at Cape Henlopen State Park in Delaware in August 2011, which was the first green sea turtle nesting ever observed north of Virginia (Murray, 2011). While nesting abundance has been monitored at these sites for decades, in-water abundance in the Gulf of Mexico or along the Atlantic coast remains unavailable (Seminoff et al., 2015). Adult and juvenile males and females from nesting colonies in the Yucatan Peninsula (Mexico), Aves Island (Venezuela), Galibi Reserve (Suriname), and Isla Trindade (Brazil) could also occur in the waters of the Study Area.

The Marine Turtle Specialist Group (under the International Union for Conservation of Nature's Species Survival Commission) conducted a worldwide analysis of the green sea turtle population based on 32 index nesting sites around the world (Seminoff & Marine Turtle Specialist Group Green Turtle Task Force, 2004). The analysis concluded there has been a 48–65 percent decline in the number of females nesting annually over the past 100 to 150 years. About 80 percent of nesting in the Western Atlantic Ocean occurs at Tortuguero, Costa Rica (Seminoff et al., 2015).

Generally, nesting trends in the Western Atlantic Ocean are stable to increasing and are increasing in Florida, as shown by annual total nest counts for green sea turtles on Florida's index beaches (27 out of 215 nesting beaches selected to monitor long-term nesting trends). Green turtle nest counts in Florida have increased by a factor of 80 since counts began in 1989 (Florida Fish and Wildlife Conservation Commission, 2017). In 2017, green turtle nest counts on the 27 core index beaches reached a new record high with almost 39,000 nests recorded. Green turtles set record highs in 2011, 2013, 2015, and 2017. The nest count in 2017 was almost 40 percent higher than the 2015 previous record. Nesting green turtles tend to follow a two-year reproductive cycle. Typically, there are wide year-to-year fluctuations in the number of nests recorded (Florida Fish and Wildlife Conservation Commission, 2017).

Although these data appear to present an encouraging global outlook, datasets for fewer than half of these sites (9 of 23) document a time span of longer than 20 years, which limits the strength of the data. A standard timeframe of data that would be necessary to properly assess population trends is three generations, which for the green sea turtle is between 100 and 150 years. Consequently, the impact of changes in juvenile recruitment that occurred four decades ago may not yet be manifested in changes in nesting abundance (Seminoff et al., 2015).

3.8.2.2.1.4 Predator and Prey Interactions

The green sea turtle is the only species of sea turtle that, as an adult, primarily consumes plants and other types of vegetation (Mortimer, 1995; Nagaoka et al., 2012). While primarily herbivorous, a green sea turtle's diet changes substantially throughout its life. Very young green sea turtles are omnivorous (Bjorndal, 1997). Salmon et al. (2004) reported that post-hatchling green sea turtles were found to feed near the surface on seagrasses or at shallow depths on comb jellies and unidentified gelatinous eggs off the coast of southeastern Florida. Nagaoka et al. (2012) analyzed 50 incidentally caught juvenile green sea turtles in Brazil and determined that juveniles consumed an omnivorous diet, including terrestrial plants (floating in the water), algae, invertebrates, and seagrass. Black mangrove leaves were of the greatest importance to diet at this location (adjacent to a black mangrove forest). Sampson and Giraldo (2014) observed opportunistic foraging of tunicates (a type of filter-feeding marine invertebrate) by green sea turtles in the eastern tropical Pacific. Pelagic juveniles smaller than 8–10 inches (in.) in length eat worms, young crustaceans, aquatic insects, grasses, and algae (Bjorndal, 1997). After settling in coastal juvenile developmental habitat at 8–10 in. in length, they eat mostly mangrove leaves, seagrass and algae (Balazs et al., 1994; Nagaoka et al., 2012). Research indicates that green sea turtles in the open-ocean environment, and even in coastal waters, also consume jellyfish, sponges, and sea pens (Hatase et al., 2006; Seminoff et al., 2015). Fukuoka et al. (2016) also noted that juvenile green sea turtles were at higher risk to marine debris ingestion, likely due to the resemblance of small pieces of debris to omnivorous dietary items.

The loss of eggs to land-based predators such as mammals, snakes, crabs, and ants occurs on some nesting beaches. As with other sea turtles, hatchlings may be preyed on by birds and fish. Sharks are the primary nonhuman predators of juvenile and adult green sea turtles at sea (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 1991; Seminoff et al., 2015).

3.8.2.2.1.5 Species-Specific Threats

In addition to the general threats described previously in Section 3.8.2.1.5 (General Threats), damage to seagrass beds and declines in seagrass distribution can reduce foraging habitat for green sea turtles (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 1991; Seminoff et al., 2015). Green sea turtles are susceptible to the disease fibropapillomatosis, which causes tumor-like growths (fibropapillomas) resulting in reduced vision, disorientation, blindness, physical obstruction to swimming and feeding, increased susceptibility to parasites, and increased susceptibility to entanglement (Balazs, 1986; National Marine Fisheries Service & U.S. Fish and Wildlife Service, 1991; Patrício et al., 2016; Work & Balazs, 2013). Some populations (e.g., the Florida population) have begun to show resistance to the disease, but it remains an issue for others, such as Pacific populations, and Hawaii's green sea turtles in particular (Chaloupka et al., 2009; Seminoff et al., 2015). Patrício et al. (2016) noted that fibropapillomatosis recovery was likely in a resident population in Puerto Rico, with tumor regression occurring within three years of formation. Other factors, such as increased stressors and selection of healthy turtles during illegal poaching activities may increase susceptibility of turtles (Patrício et al., 2016).

3.8.2.2.2 Hawksbill Sea Turtle (*Eretmochelys imbricata*)

3.8.2.2.2.1 Status and Management

The hawksbill turtle is listed as endangered under the ESA (35 *Federal Register* 8491). While the current listing as a single global population remains valid, data may support separating populations at least by ocean basin under the distinct population segment policy (National Marine Fisheries Service & U. S. Fish and Wildlife Service, 2007). The most recent status review document was released in 2013 by the NMFS and USFWS (National Marine Fisheries Service, 2013a).

Critical habitat has been designated in the Study Area, as shown in Figure 3.8-5. Critical habitat for hawksbill terrestrial nesting areas was designated in Puerto Rico in 1982. This designation includes portions of Mona Island, Culebra Island, Cayo Norte, and Island Culebrita, from the mean high tide line to a point 150 meters (m) from shore. Critical marine habitat was also designated in 1998 for the coastal waters surrounding Mona and Monito Islands, Puerto Rico, from the mean high water line seaward to 3 NM (National Marine Fisheries Service, 2013a). Critical habitat includes (1) coral reefs for food and shelter and (2) nesting beaches. The essential physical and biological features of coral reefs support a large, long-term juvenile hawksbill population, in addition to subadults and adults. The types of sponges that hawksbills prefer for food are found on the reefs around these islands. Reef ledges and caves also provide resting areas and protection from predators. Nesting beaches on Mona Island support the largest population of nesting hawksbill turtles in the U.S. Caribbean (National Marine Fisheries Service, 2013a).

3.8.2.2.2.2 Habitat and Geographic Range

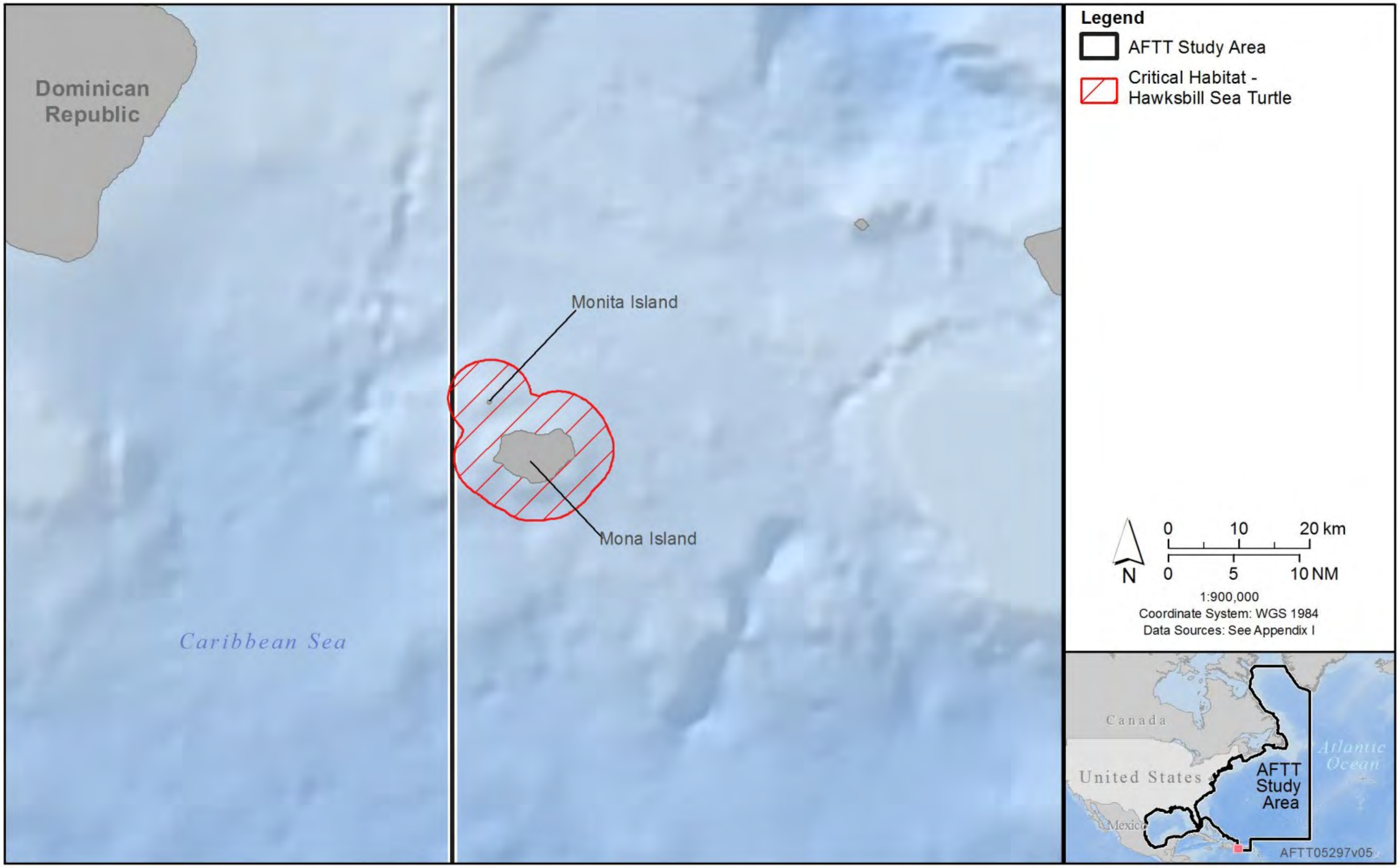
The hawksbill is the most tropical of the world's sea turtles, rarely occurring above 35° north or below 30° south (Witzell, 1983). While hawksbills are known to occasionally migrate long distances in the open ocean, they are primarily found in coastal habitats and use nearshore areas more exclusively than other sea turtles. Hatchlings in the AFTT Study Area are believed to occupy open-ocean waters, associating themselves with surface algal mats in the Atlantic Ocean (Parker, 1995; Witherington & Hirama, 2006; Witzell, 1983). Juveniles leave the open-ocean habitat after three to four years and settle in coastal foraging areas, typically coral reefs but occasionally seagrass beds, algal beds, mangrove bays, and creeks (Mortimer & Donnelly, 2008).

Less is known about the hawksbill's oceanic stage, but it is thought that neonates live in the oceanic zone where water depths are greater than 200 m. Distribution in the oceanic zone may be influenced by surface gyres (Leon & Bjorndal, 2002; National Marine Fisheries Service, 2013a).

Juveniles and adults share the same foraging areas, including tropical nearshore waters associated with coral reefs, hard bottoms, or estuaries with mangroves (Musick & Limpus, 1997). In nearshore habitats, resting areas for late juvenile and adult hawksbills are typically in deeper waters, such as sandy bottoms at the base of a reef flat (Houghton et al., 2003). As they mature into adults, hawksbills move to deeper habitats and may forage to depths greater than 90 m. During this stage, hawksbills are seldom found in waters beyond the continental or insular shelf unless they are in transit between distant foraging and nesting grounds (Renaud et al., 1996). Ledges and caves of coral reefs provide shelter for resting hawksbills during both day and night, where an individual often inhabits the same resting spot. Hawksbills are also found around rocky outcrops and high-energy shoals, where sponges are abundant, and in mangrove-fringed bays and estuaries. Female hawksbills return to their natal beach every two to three years to nest at night, every 14—16 days during the nesting season.

In the Caribbean Sea and Gulf of Mexico Large Marine Ecosystems, the principal nesting season is from June to November (Hillis, 1990), with only rare nesting activity in Florida, which is restricted to Volusia, Martin, Palm Beach, Broward, Miami-Dade, and Monroe Counties (Meylan et al., 2006; National Marine Fisheries Service, 2013a). Throughout their range, hawksbill turtles typically nest in low densities; aggregations of nesting activity that usually include approximately 20 nests, but can exceed a few hundred nests in some locations (National Marine Fisheries Service, 2013a).

The greatest hawksbill turtle numbers in the southeastern United States are found off the coast of southern Florida. There, hawksbills are documented from winter to summer from Palm Beach, Broward, and Dade Counties to the Florida Keys, and to coastal waters just northwest of Tampa Bay, where the northernmost stranding records typically occur. Foraging juveniles and adults settle on coral reef and hard-bottom habitats off southern Florida throughout the year (Musick & Limpus, 1997). Hawksbill turtle sightings in waters off the Florida panhandle, Alabama, Mississippi, Louisiana, and Texas (Rester & Condrey, 1996; Witzell, 1983), though rare, are likely of early juveniles born on nesting beaches in Mexico that have drifted north with the dominant currents (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 1993).



Note: AFTT: Atlantic Fleet Training and Testing

Figure 3.8-5: Critical Habitat Designation for the Hawksbill Sea Turtle within the Study Area

3.8.2.2.2.3 Population Trends

Since the last five-year status review for hawksbill turtles (National Marine Fisheries Service & U. S. Fish and Wildlife Service, 2007), recent information on nesting populations in the eastern Pacific and the Nicaragua nesting population in the western Caribbean appears to have improved (National Marine Fisheries Service, 2013a). Global trends and distribution, however, have remained the same. An estimated 22,004–29,035 turtles nest each year in the Atlantic, Indian, and Pacific oceans; of these, 3,626–6,108 occur in the Atlantic Ocean alone. Historical population trends showed overall declines for the 20- to 100-year period of evaluation. Among the 88 sites worldwide for which historic trends could be assessed, 63 (72 percent) showed a decline. Shorter-term population trends, however, show more increases at some nesting sites, particularly in the north Atlantic and Pacific Oceans with 10 (24 percent) increasing, 3 (7 percent) stable, and 28 (68 percent) decreasing (National Marine Fisheries Service, 2013a).

3.8.2.2.2.4 Predator and Prey Interactions

Hawksbill turtles have a varying diet and feeding habitat preference throughout different lifestages. Post-hatchling hawksbills feed on floating habitats (e.g., *Sargassum*) in the open ocean (Bresette et al., 1998; Plotkin & Amos, 1998; Van Houtan et al., 2016). During the later juvenile stage, hawksbills are considered omnivorous, feeding on sponges, sea squirts, algae, molluscs, crustaceans, jellyfish, and other aquatic invertebrates (Bjorndal, 1997). Older juveniles and adults are more specialized, feeding primarily on sponges, which compose as much as 95 percent of their diet in some locations (Meylan, 1988; Witzell, 1983). As adults, Hawksbill turtles fill a unique ecological niche in marine and coastal ecosystems, supporting the natural functions of coral reefs by keeping sponge populations in check (Hill, 1998; Leon & Bjorndal, 2002). Feeding on sponges helps to control populations of sponges that may otherwise compete for space with reef-building corals (Hill, 1998; Leon & Bjorndal, 2002).

The loss of hawksbill eggs to predators such as feral pigs, mongoose, rats, snakes, crabs, and ants is a severe problem on some nesting beaches. As with other sea turtles, hatchlings may be preyed on by birds and fish. Sharks are the primary nonhuman predators of juvenile and adult hawksbills at sea (National Ocean Service, 2016; Southern California Marine Institute, 2016).

3.8.2.2.2.5 Species-Specific Threats

In addition to the general threats described in Section 3.8.2.1.5 (General Threats), the greatest threat to hawksbills is harvest for commercial and subsistence use. Direct harvest of eggs and nesting adult females from beaches, as well as direct hunting of turtles in foraging areas, continues in many countries. International trade of tortoise shells is thought to be the most important factor endangering the species worldwide. The second-most significant threat to hawksbill sea turtles is loss of nesting habitat caused by the expansion of human populations in coastal areas of the world, as well as the increased destruction or modification of coastal ecosystems to support tourism (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 1998a). Coastal pollution as a result of increased development degrades water quality, particularly coral reefs, which are primary foraging areas for hawksbills. Due to their preference for nearshore areas, hawksbills are particularly susceptible to nearshore fisheries gear such as drift nets, entanglement in gill nets, and capture on fish hooks of fishermen (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 1993; National Marine Fisheries Service, 2013a).

3.8.2.2.3 Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)

3.8.2.2.3.1 Status and Management

The Kemp's ridley sea turtle is listed as a single population and is classified as endangered under the ESA (35 *Federal Register* 18319). The most recent status review was released in 2015 by the USFWS and NMFS (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2015). There is no critical habitat currently designated for this species. In 2010, the USFWS and NMFS received a petition to designate critical habitat on nesting beaches in Texas and along gulf coast states. The petition is still under consideration, and no proposed rule on the establishment of critical habitat has been released by either agency.

3.8.2.2.3.2 Habitat and Geographic Range

Kemp's ridley turtle nesting is essentially limited to the beaches of the western Gulf of Mexico, primarily in Tamaulipas, Mexico. Nesting also occurs in Veracruz, and a few historical records exist for Campeche, Mexico. Since 1978, the U.S. National Park Service, in partnership with USFWS, NMFS, Texas Parks and Wildlife Department, and the Instituto Nacional de Pesca (a Mexican federal agency), has led an effort to increase Kemp's ridley turtle nesting at Padre Island National Seashore, south Texas, to form a secondary nesting colony to safeguard against extinction (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2011). Occasional nesting has been reported from Florida, Alabama, Georgia, South Carolina, North Carolina, with the furthest north nesting occurring in Virginia (in 2012 and 2014) (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2015). Shaver et al. (2016) has noted that the known nesting range for the Kemp's ridley turtle has expanded since the late 1980s, possibly due to "head start" releases in Florida. Head starting is an accepted conservation intervention involving captive rearing and release of sea turtles, but the range expansion may also be associated with increased nesting numbers (Shaver et al., 2016).

Habitats frequently used by Kemp's ridley sea turtles in U.S. waters are warm-temperate to subtropical sounds, bays, estuaries, tidal passes, shipping channels, and beachfront waters, where their preferred food, the blue crab, is abundant (Lutcavage & Musick, 1985). The general migration pattern of females begins with travel through relatively shallow migratory corridors toward the nesting beach in the late winter in order to arrive at the nesting beach by early spring. Males and females can loop along the U.S. continental shelf large marine ecosystem in the spring, and back down the southeast U.S. continental shelf in the fall. From nesting beaches in the Gulf of Mexico, the migratory corridor traverses neritic areas of the Mexico and U.S. Gulf coasts with a mean water depth of 26 m approximately 20 kilometers (km) from the coast, occurring in late May through August with a peak in June (Shaver et al., 2016). Kemp's ridley turtles that headed north and east traveled as far as the waters off southwest Florida; however, waters off the upper Texas coast through Mississippi, especially off Louisiana, appear to be a "hotspot" as turtles returned to the area to forage over multiple years (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2015).

Evidence suggests that post-hatchling and small juvenile Kemp's ridley sea turtles, similar to loggerhead and green sea turtles of the same region, forage and develop in floating *Sargassum* habitats of the North Atlantic Ocean. Juveniles migrate to habitats along the U.S. Atlantic continental shelf from Florida to New England (Morreale & Standora, 1998; Peña, 2006) at around two years of age. A tag study funded by the U.S. Navy and completed by Barco and Lockhart (2015) indicates that waters off of Norfolk Naval Base and the Chesapeake Bay may be foraging grounds while juveniles are in transit along the Atlantic coast. Migrating juvenile Kemp's ridleys travel along coastal corridors generally shallower than 50 m in bottom depth (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2011). Suitable developmental habitats are seagrass beds and mud bottoms in waters of less than 10 m bottom depth and with sea surface temperatures between 72 degrees Fahrenheit (°F) and 90°F (22 degrees Celsius [°C] and 32°C) (Coyne et al., 2000).

Important year-round developmental habitats in the northern Gulf of Mexico include the western coast of Florida (particularly the Cedar Keys area), the eastern coast of Alabama, and the mouth of the Mississippi River (Lazell, 1980; Lutcavage & Musick, 1985; Weber, 1995). Coastal waters off western Louisiana and eastern Texas also provide adequate habitats for bottom feeding. Verkaik et al. (2016) found strong site fidelity within and between years to the Mississippi Sound during spring, summer, and fall for juvenile Kemp's ridley turtles. During the winter, turtles migrated to the nearshore waters of Louisiana.

As adults, many turtles remain in the Gulf of Mexico Large Marine Ecosystem, with only occasional occurrence in the Atlantic Ocean (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2011). While the understanding of adult males' distribution and habitat usage is limited, satellite telemetry of males caught near Padre Island, Texas, indicates that they do not migrate, remaining year-round in nearshore waters of less than 50 m. Many of the post-nesting females from Rancho Nuevo migrate north to areas offshore of Texas and Louisiana (Marquez, 1994). Farther south, some post-nesting females migrate from Rancho Nuevo to the northern and western Yucatán Peninsula in the Southern Gulf of Mexico, which contains important seasonal foraging sites for adult females—specifically the Bay of Campeche (Marquez, 1994; Márquez, 1990; Pritchard & Marquez, 1973).

3.8.2.2.3.3 Population Trends

The earliest estimate of population size was derived from analyzing archival film footage of a large arribada (mass nesting) event in 1947 and other life history information of the Kemp's ridley turtle. From these data sources and the analysis of the raw footage, Gonzalez (2011) suggest that the Kemp's ridley population during and prior to the 1947 nesting season was relatively robust, with the estimated number of nests exceeding 121,000. The lowest point in the decline of Kemp's ridleys occurred in 1985 (approximately 700 nests), representing a 99 percent decline in the number of nests compared to the 1947 estimate. Although the Kemp's ridley population has shown increases since 1985, the rate of recovery has declined in recent years. In 2010, Kemp's ridley nesting showed a steep decline (35 percent) followed by some recovery to 2009 levels, with other declines in 2013 and 2014 (Caillouet et al., 2016; National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2015; Shaver et al., 2016). The numbers of Kemp's ridley sea turtle nests counted along Texas beaches have increased from 2015 (159 nests) to 2016 (186 nests) and 2017 (353 nests) (Shaver, 2018).

Subadult and adult females were presumed to have suffered a high mortality rate in 2009, which has manifested in a 40 percent decline in nesting activity in Mexico and Texas. The causes of this mortality event and the ramifications for population recovery and growth rates are still being analyzed (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2015).

3.8.2.2.3.4 Predator and Prey Interactions

Kemp's ridley sea turtles feed primarily on crabs but are also known to prey on molluscs, shrimp, fish, jellyfish, and plant material (Frick et al., 1999; Marquez, 1994; Seney, 2016). Plant material, primarily macroalgae, is likely consumed incidentally with invertebrate prey items (Seney, 2016). Blue crabs and spider crabs are important prey species for the Kemp's ridley (Keinath et al., 1987; Lutcavage & Musick, 1985; Seney, 2016). They may also feed on shrimp fishery bycatch (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 1993), and Servis et al. (2015) noted instances of fish and horseshoe crab predation, indicating that Kemp's ridley turtles may opportunistically feed to supplement their diet.

Major predators of Kemp's ridley sea turtle eggs and hatchlings on nesting beaches include raccoons, dogs, feral pigs, skunks, badgers, and fire ants. Predatory fishes such as jackfish and redfish may feed on hatchlings at sea. Sharks are the primary predator of juvenile and adult Kemp's ridley sea turtles (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2011).

3.8.2.2.3.5 Species-Specific Threats

Because the Kemp's ridley turtle is very range limited, the general threats facing sea turtles described previously may increase impacts on this species. For example, energy extraction and development in the Gulf of Mexico are a particular threat to Kemp's ridley sea turtles because most of the nesting activity occurs there (Shaver & Caillouet, 1998). Kemp's ridley sea turtles periodically strand on beaches in Mexico covered in crude oil, and most of the turtles found injured and dead following the *Deepwater Horizon* oil spill were Kemp's ridley sea turtles (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2011; Wilkin et al., 2017). It should be noted that the dramatic reversal of an increasing nesting trend in the Gulf of Mexico followed the *Deepwater Horizon*, and the removal of a cohort of Kemp's ridleys that would be sexually mature now may be responsible for declines shown in 2013 and 2014 (Caillouet et al., 2016; Putman et al., 2015a). Shrimp trawling in the southeastern U.S. Atlantic and Gulf of Mexico was once a significant threat to Kemp's ridleys; however, the use of turtle excluder devices and the general decline of shrimp fishing in recent years have greatly reduced mortality levels (Caillouet et al., 2008; Nance et al., 2012). Vehicle activity on sea turtle nesting beaches can also disrupt the nesting process, crush nests, and create ruts and ridges in the sand that pose obstacles to turtles (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2011). Beach vehicular driving is permitted on most beaches in Texas, where adult turtles and hatchlings have been crushed by passing vehicles, as well as on some beaches in Mexico.

3.8.2.2.4 Loggerhead Turtle (*Caretta caretta*)

3.8.2.2.4.1 Status and Management

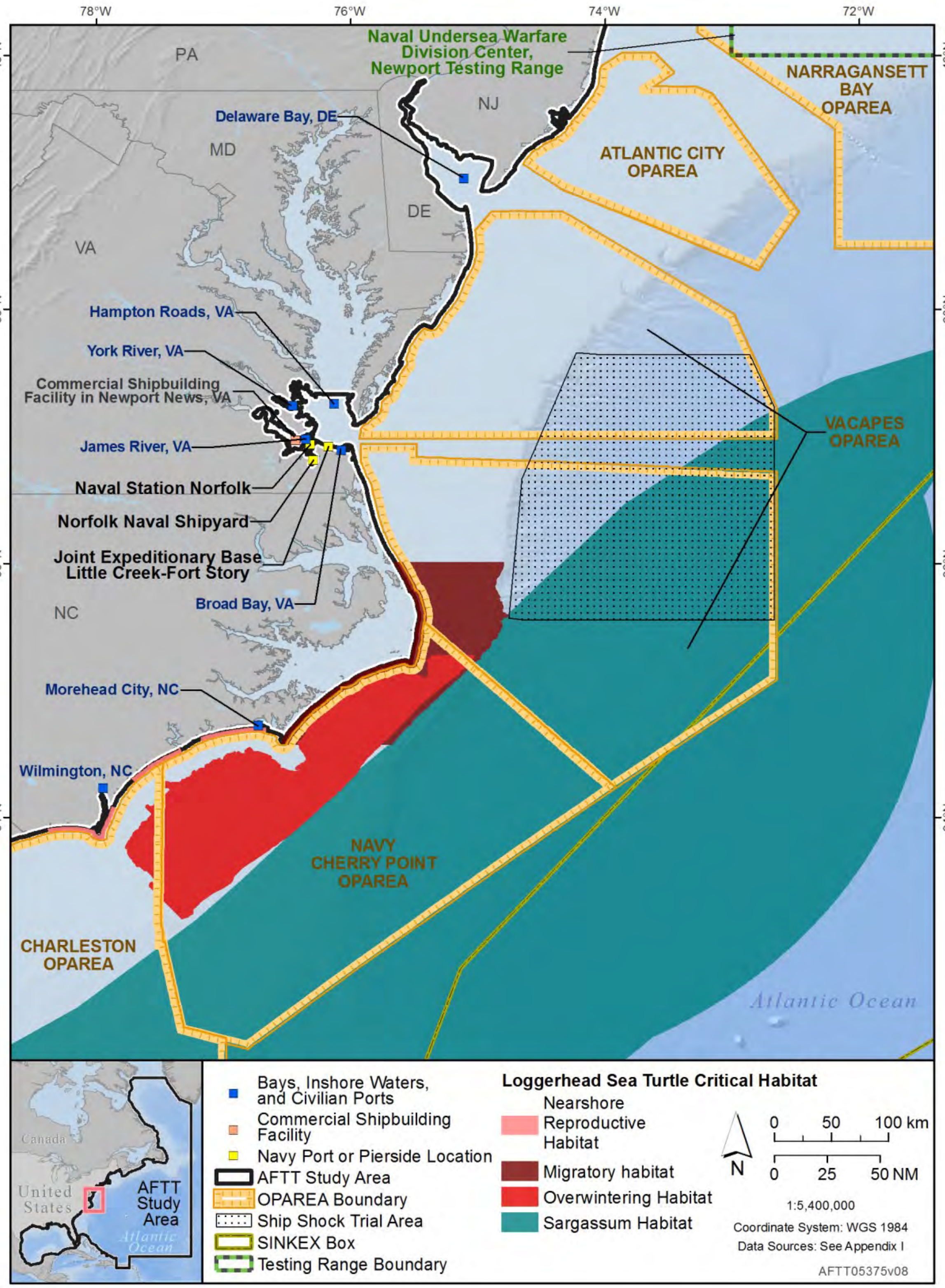
In 2009, a status review conducted for the loggerhead (the first turtle species subjected to a complete stock analysis) identified nine distinct population segments within the global population (Conant et al., 2009). In a September 2011 rulemaking, the NMFS and USFWS listed five of these distinct population segments as endangered and kept four as threatened under the ESA, effective as of October 24, 2011 (76 Federal Register 58868). The North Pacific Ocean, South Pacific Ocean, North Indian Ocean, Northeast Atlantic Ocean, and Mediterranean Sea distinct population segments of the loggerhead sea turtle are classified as endangered under the ESA, and the Southeast Indo-Pacific Ocean, Southwest Indian Ocean, Northwest Atlantic Ocean, and South Atlantic Ocean distinct population segments are classified as threatened. The Northwest Atlantic Ocean distinct population segment is the only one that occurs entirely within the Study Area; however, loggerheads from other distinct population segments may occur rarely within the Study Area. For example, mixing likely occurs, rarely, with South Atlantic loggerheads enabling a limited amount of gene flow between these two distinct population segments (National Marine Fisheries Service, 2010; Tucker et al., 2014). Critical Habitat has been designated within the Study Area, and is shown in Figure 3.8-6 (for critical habitat along the mid-Atlantic coast), Figure 3.8-7 (for critical habitat along southeast Atlantic states), and Figure 3.8-8 (for critical habitat in the Gulf of Mexico).

Specific areas designated as critical habitat include 38 occupied marine areas within the range of the Northwest Atlantic Ocean distinct population segment of loggerhead turtles (79 *Federal Register* 39856). In order to characterize different use patterns and concentrations both seasonally and geographically, the NMFS named five different habitat types that comprise the critical habitat designation, which include (1) nearshore reproductive habitat (portions of nearshore waters adjacent to nesting beaches used by females and hatchlings to egress to open-water environments), (2) winter habitats (warm waters south of Cape Hatteras where juveniles and adults tend to concentrate during winter months), (3) breeding habitats (areas with high concentrations of both male and female adults during the breeding season in proximity to Florida migratory corridor and nesting grounds), (4) constricted migratory habitat (migratory corridors restricted in width), (5) *Sargassum* habitat (juvenile loggerhead developmental habitats where *Sargassum* supports adequate prey abundance and cover) (National Marine Fisheries Service, 2014b). Physical and biological features that support the five habitat types summarized above for loggerhead sea turtle conservation include oceanic conditions that would concentrate certain life-stage loggerheads together at different locations and in different seasons. The USFWS designated approximately 685 miles of nesting beaches (in North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi) in a separate rulemaking (79 *Federal Register* 51264), which is also shown on Figure 3.8-6, Figure 3.8-7, and Figure 3.8-8.

None of these critical habitat areas include Department of Defense areas of Marine Corps Base Camp Lejeune (Onslow Beach), Cape Canaveral Air Force Station, Patrick Air Force Base, and Eglin Air Force Base, which are exempt from critical habitat designation because their Integrated Natural Resources Management Plans incorporate measures that provide a benefit for the conservation of the loggerhead sea turtle.

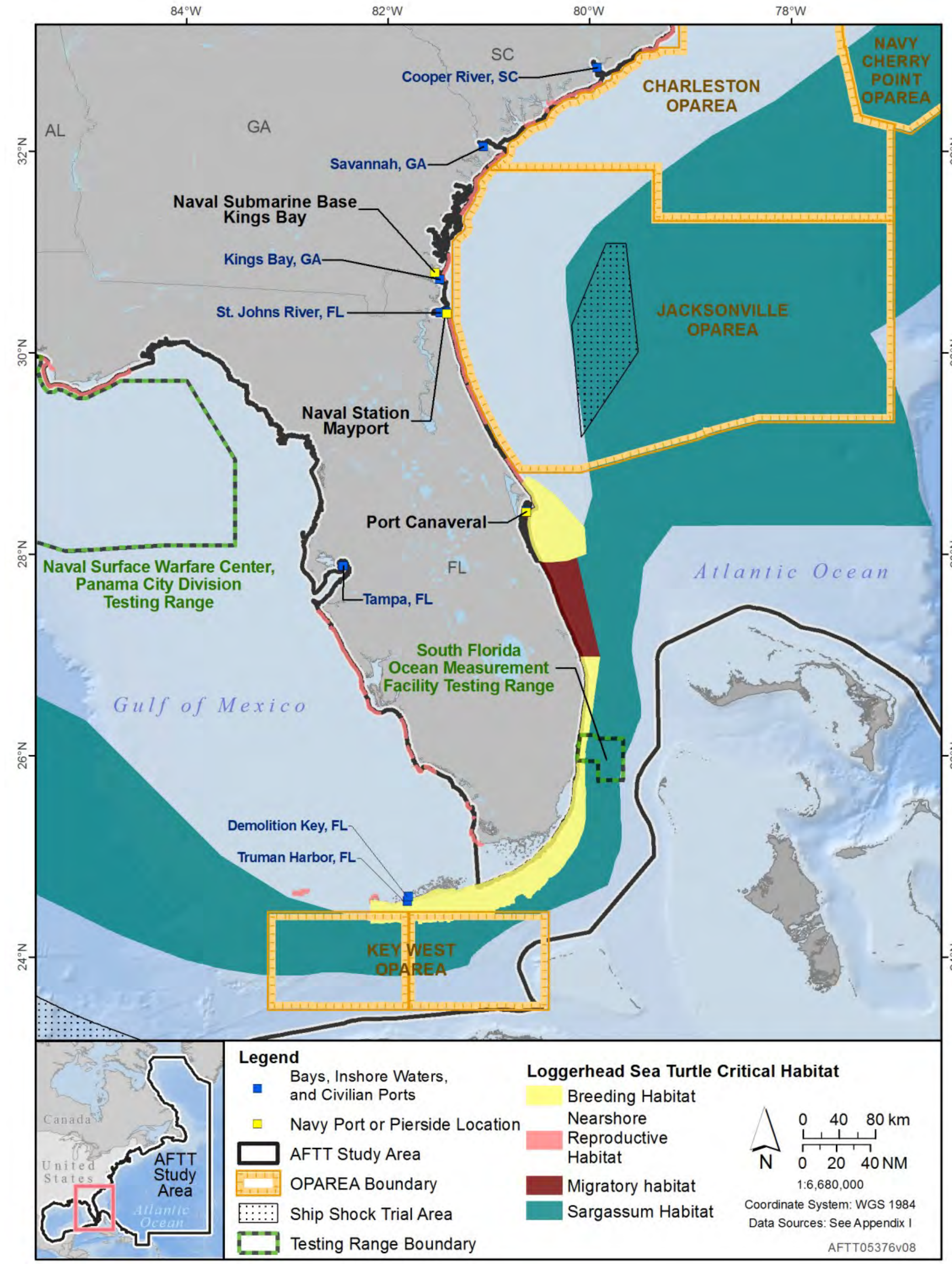
3.8.2.2.4.2 Habitat and Geographic Range

Loggerhead turtles occur in U.S. waters in habitats ranging from coastal estuaries to waters far beyond the continental shelf (Chapman & Seminoff, 2016; Dodd, 1988). Loggerheads typically nest on beaches close to reef formations and in close proximity to warm currents (Dodd, 1988), preferring beaches facing the ocean or along narrow bays (National Marine Fisheries Service, 2014b; Reece et al., 2013). Nesting in the Study Area occurs from April through September, with a peak in June and July (Dodd, 1988; Weishampel et al., 2006; Williams-Walls et al., 1983). Large nesting colonies exist in Florida, with more limited nesting along the Gulf coast and north through Virginia. At emergence, hatchlings swim to offshore currents and remain in the open ocean, often associating with floating mats of *Sargassum* (Carr, 1986, 1987; Witherington & Hirama, 2006). Nesting activity within the North Atlantic Ocean distinct population segment include the eastern Bahamas, southwestern Cuba, the eastern Caribbean Islands, and numerous locations from the Yucatán Peninsula to Virginia (Conant et al., 2009; National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2007; National Marine Fisheries Service, 2010). Within the United States, the highest concentration of loggerhead nesting occurs in Florida, discussed in more detail in Section 3.8.2.2.4.3 (Population Trends), with additional nesting reported in Texas, Alabama, Georgia, North Carolina, and Virginia. Genetic studies indicate that, although females routinely return to natal beaches, males may breed with females from multiple populations and facilitate gene flow (Bowen et al., 2005).



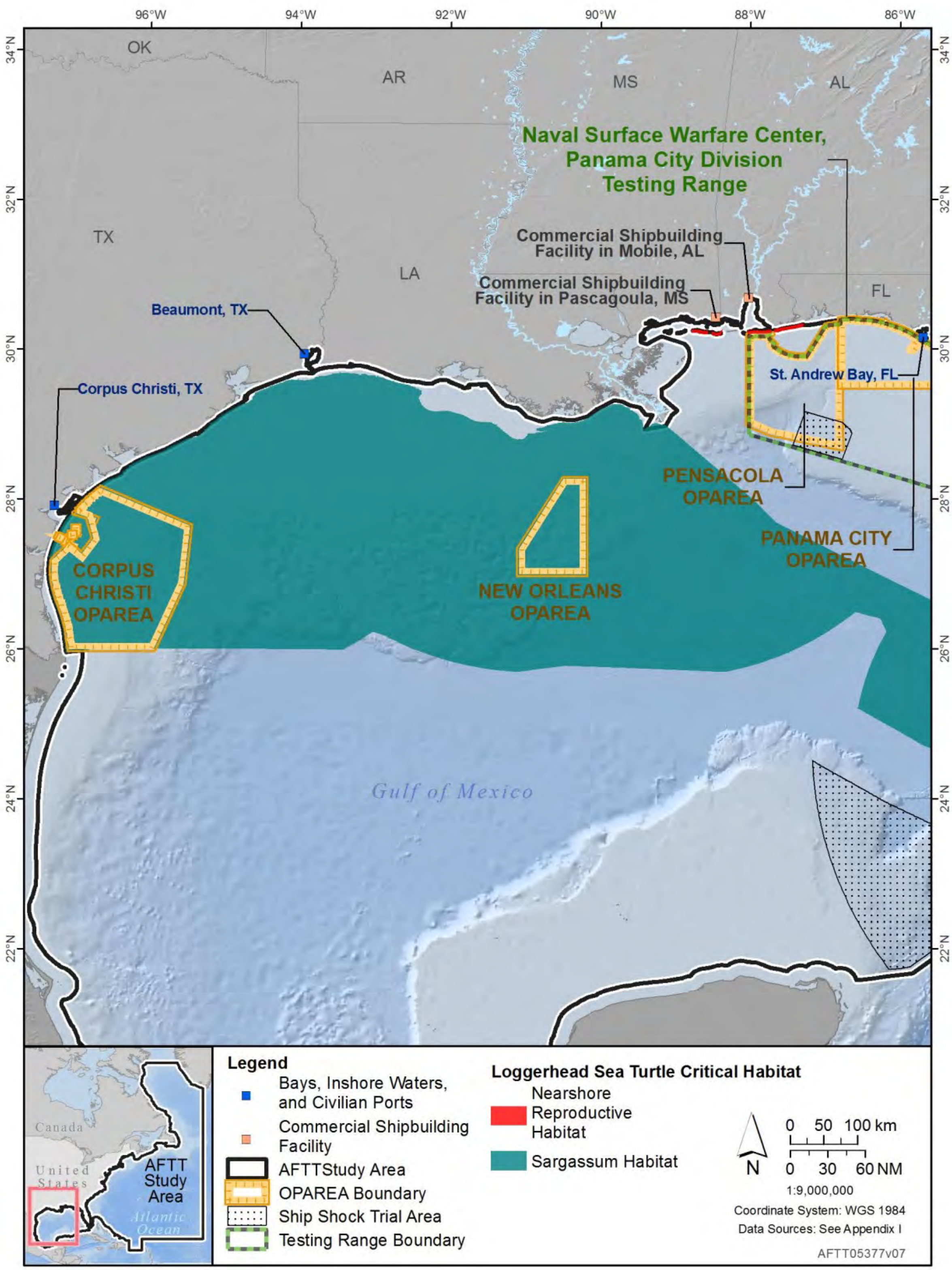
Notes: AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area

Figure 3.8-6: Critical Habitat Designation for the Loggerhead Turtle within the Study Area: Mid-Atlantic



Notes: AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area

Figure 3.8-7: Critical Habitat Designation for the Loggerhead Turtle within the Study Area: Southeast



Notes: AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area

Figure 3.8-8: Critical Habitat Designation for the Loggerhead Turtle within the Study Area: Gulf of Mexico

Migration between oceanic and nearshore habitats occurs during the juvenile stage as turtles move seasonally from open-ocean current systems to nearshore foraging areas (Bolten, 2003a; Mansfield, 2006). After reaching a length of 40 centimeters (cm) (Carr, 1987), early juvenile loggerheads make a transoceanic crossing, swimming back to nearshore feeding grounds near their beach of origin in the western Atlantic Ocean (Bowen et al., 2004; Musick & Limpus, 1997). Juveniles are frequently observed in developmental habitats, including coastal inlets, sounds, bays, estuaries, and lagoons with depths less than 100 m (Hopkins-Murphy et al., 2003). Based on growth rate estimates, the duration of the open-ocean juvenile stage for North Atlantic loggerhead sea turtles is estimated to be 8.2 years (Bjorndal et al., 2000).

Juvenile loggerhead sea turtles inhabit offshore waters in the North Atlantic Ocean. These offshore habitats provide juveniles with an abundance of prey and sheltered locations where they can rest (Rosman et al., 1987). Loggerheads are generally observed in the northern extent of their range during the summer, in shallow water habitats with large expanses of open-ocean access. This summer distribution extends into the Gulf of Maine and waters over the Scotian Shelf, with some individuals venturing as far north as Newfoundland (Arendt et al., 2012; Bolten et al., 1992; National Marine Fisheries Service, 2010; Witherington & Hirama, 2006). Juveniles also use the strong current of the North Atlantic Gyre to move from developmental nursery habitats to later developmental habitats, and to and from adult foraging, nesting, and breeding habitats (Bolten et al., 1998; Musick & Limpus, 1997). Small bottom-feeding juveniles in Delaware Bay are the predominant loggerhead size class found along the northeast and mid-Atlantic U.S. coast, while adults inhabit the entire continental shelf area (Hopkins-Murphy et al., 2003). Long Island Sound, Cape Cod Bay, and Chesapeake Bay are the most frequently used juvenile developmental habitats along the Northeast U.S. Continental Shelf Large Marine Ecosystem (Mansfield, 2006).

Navy-funded aerial surveys and stranding data suggest that this species is the most abundant sea turtle species using Chesapeake Bay and waters off of Cape Hatteras (Andrady, 2011; Barco & Lockhart, 2015; Burt et al., 2014; National Oceanic and Atmospheric Administration, 2015; Swingle et al., 2016). Abundances in these waters were highest in the spring relative to summer and fall, with no presence in winter (Burt et al., 2014). Core Sound and Pamlico Sound, North Carolina, on the border between the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems, represent important developmental habitat for juvenile loggerheads (Epperly et al., 1995a). Although these habitats are also used by greens and Kemp's ridleys, loggerheads are the most abundant sea turtle species within the summer developmental habitats of North Carolina (Epperly et al., 1995a; Epperly et al., 1995b; Epperly et al., 1995c). In a sampling study from 2004 to 2007, juveniles were the most abundant age group among loggerheads found in the Charleston, South Carolina, shipping channel between May and August (Arendt et al., 2012). Immature loggerhead sea turtles may occupy coastal feeding grounds for 20 years before their first reproductive migration (Bjorndal et al., 2001; Putman et al., 2015b).

Sub-adult and adult loggerhead turtles tend to inhabit deeper offshore feeding areas along the western Atlantic coast, from mid-Florida to New Jersey (Hopkins-Murphy et al., 2003; Roberts et al., 2005). As late juveniles and adults, loggerhead sea turtles most often occur on the continental shelf and along the shelf break of the U.S. Atlantic and Gulf coasts, as well as in coastal estuaries and bays (Putman et al., 2015b). Hawkes et al. (2006) found that adult females forage predominantly in shallow coastal waters along the U.S. Atlantic coast less than 100 m deep, likely exploiting bottom-dwelling prey.

As water temperatures drop from October to December, most loggerheads emigrate from their summer developmental habitats and eventually return to warmer waters south of Cape Hatteras, where they spend the winter (Morreale & Standora, 1998). From a southwestern Florida nesting location, Tucker et al. (2014) tracked nine loggerheads over multiple nesting seasons, showing five distinct winter migration destinations—islands in the Caribbean, Florida Keys, West Florida Shelf, northern Gulf of Mexico, and Yucatan Peninsula. Bovery and Wyneken (2015) analyzed seasonal variation in sea turtle density and abundance off southeastern Florida, and found that loggerheads were the most frequently sighted species, with increased sightings in spring. Turtles were often found in coastal waters that were west of the Florida Current (approximately 20 km offshore).

Griffin et al. (2013) offered a conceptual model of foraging strategies, as shown by tagged loggerhead turtles from Georgia, South Carolina, and North Carolina nesting beaches. These strategies included seasonal strategies and year-round strategies, with summer prevalence in waters north of Cape Hatteras along neritic habitats to Cape Canaveral, Florida, with winter foraging occurring further out on the mid to outer continental shelf. Large juvenile and adult loggerhead turtles are captured or observed along Florida's Atlantic coast year-round (Bovery & Wyneken, 2015; Pajuelo et al., 2016). As stated previously, loggerheads were the highest occurring sea turtle species within the AFTT Study Area, with higher occurrences in spring (Bovery & Wyneken, 2015).

3.8.2.2.4.3 Population Trends

There are at least five demographically independent loggerhead sea turtle nesting groups or subpopulations of the Northwest Atlantic Ocean: (1) the Northern Recovery Unit, from the Florida-Georgia border to southern Virginia; (2) the Peninsular Florida Recovery Unit, along Florida's Atlantic coast to Key West; (3) the Dry Tortugas Recovery Unit, encompassing all islands west of Key West; (4) the Northern Gulf of Mexico Recovery Unit, from the Florida panhandle through Texas; and (5) the Greater Caribbean Recovery Unit, from Mexico through French Guiana, the Bahamas, and the Lesser and Greater Antilles (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2008).

Annual total nest counts for loggerhead sea turtles on Florida's index beaches (27 beaches identified as a subset for measuring long-term nesting trends) fluctuate widely, and scientists do not yet understand fully what drives these changes. A detailed analysis of Florida's long-term loggerhead nesting data from 1989 to 2017 shows three distinct phases. Following a 52 percent increase between 1989 and 1998, nest counts declined sharply (53 percent) over nearly a decade (1998–2007). However, annual nest counts showed a strong increase (65 percent) through 2017. Overall, nest counts in Florida over the monitoring period (1989–2017) increased by approximately 19 percent (Florida Fish and Wildlife Conservation Commission, 2017).

3.8.2.2.4.4 Predator and Prey Interactions

Loggerhead sea turtles are primarily carnivorous in both open ocean and nearshore habitats, although they also consume some algae (Bjorndal, 1997), Diet varies by age class (Godley et al., 1998) and by specializing in specific prey groups dependent on location. For post hatchlings that tend to be grouped in masses of *Sargassum* and other floating habitats, various diet analyses of gut contents show parts of *Sargassum*, zooplankton, jellyfish, larval shrimp and crabs, and gastropods (Burkholder et al., 2004; Carr & Meylan, 1980; Richardson & McGillvary, 1991). Both juveniles and adults forage in coastal habitats, where they feed primarily on the bottom, although they also capture prey throughout the water column (Bjorndal, 2003). Adult loggerheads feed on a variety of bottom-dwelling animals, such as crabs, shrimp, sea urchins, sponges, and fish. They have powerful jaws that enable them to feed on hard-shelled prey, such as whelks and conch. During migration through the open sea, they eat jellyfish, molluscs, flying fish, and squid (Briscoe et al., 2016; Fukuoka et al., 2016; Pajuelo et al., 2016).

Common predators of eggs and hatchlings on nesting beaches are ghost crabs, raccoons, feral pigs, foxes, coyotes, armadillos, and fire ants (Campbell, 2016; Dodd, 1988; Engeman et al., 2016). Eriksson and Burton (2003) has shown that management interventions for feral pigs and raccoons can significantly increase nest success in Florida, one of the main nesting concentrations of loggerheads. Arroyo-Arce et al. (2017) documented an apparently rare instance of a jaguar (*Panthera onca*) in 2014 predating a loggerhead turtle at Tortuguero National Park, Costa Rica, while the turtle was on the beach. In the water, hatchlings are susceptible to predation by birds and fish. Sharks are the primary predator of juvenile and adult loggerhead sea turtles (Fergusson et al., 2000).

3.8.2.2.4.5 Species-Specific Threats

In addition to the general threats described previously, mortality associated with shrimp trawls has been a substantial threat to large juvenile and subadult loggerheads because these trawls operate in the nearshore habitats commonly used by this species. Although shrimping nets have been modified with turtle excluder devices to allow sea turtles to escape, the overall effectiveness of these devices has been difficult to assess (Bugoni et al., 2008). Shrimp trawl fisheries account for the highest number of loggerhead sea turtle fishery mortalities; however, loggerheads are also captured and killed in trawls, traps and pots, longlines, and dredges. Along the Atlantic coast of the United States, NMFS estimated that almost 163,000 loggerhead sea turtles are captured in shrimp trawl fisheries each year in the Gulf of Mexico, with 3,948 of those sea turtles dying as a result of their capture. Each year, several hundred loggerhead sea turtles are also captured in herring, mackerel, squid, butterfish, and monkfish fisheries; pound net fisheries, summer flounder, and scup fisheries; Atlantic pelagic longline fisheries; and gillnet fisheries in Pamlico Sound. Combined, these fisheries capture about 2,000 loggerhead sea turtles each year. Although most are released alive, about 700 turtles are killed annually.

Vehicle use on sea turtle nesting beaches is also an issue for loggerheads. Vehicles are allowed on some beaches in Florida, Georgia, North Carolina, Virginia, and Texas. Vehicles can run over and kill hatchlings or nesting adult turtles on the beach, disrupt the nesting process, create ruts in the sand that impede turtle movement, and crush nests (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2008).

3.8.2.2.5 Leatherback Sea Turtle (*Dermochelys coriacea*)

3.8.2.2.5.1 Status and Management

The leatherback sea turtle is listed as a single population and is classified as endangered under the ESA (35 *Federal Register* 8491). Although USFWS and NMFS believe the current listing is valid, preliminary information indicates an analysis and review of the species should be conducted under the distinct population segment policy (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2013b). Recent information on population structure (through genetic studies) and distribution (through telemetry, tagging, and genetic studies) have led to an increased understanding and refinement of the global stock structure. Leatherback sea turtles from nesting stocks originating throughout the Atlantic have the potential to be within the offshore portions of the Study Area, but only two of these—the Florida genetic stock and the Northern Caribbean genetic stock—nest on beaches in the jurisdiction of the United States.

Critical habitat has been designated in the Study Area for this species (Figure 3.8-9). In 1978, critical habitat was designated for the leatherback's terrestrial environment on St. Croix Island at Sandy Point because of its importance as a nesting habitat (43 *Federal Register* 43688). In 1979, critical habitat was designated for the waters next to Sandy Point, St. Croix, up to and including the waters from the

100-fathom curve shoreward to the mean high tide line (44 *Federal Register* 17710). The essential physical and biological feature of this critical habitat is its function as an important courtship and mating area adjacent to the nesting beach.

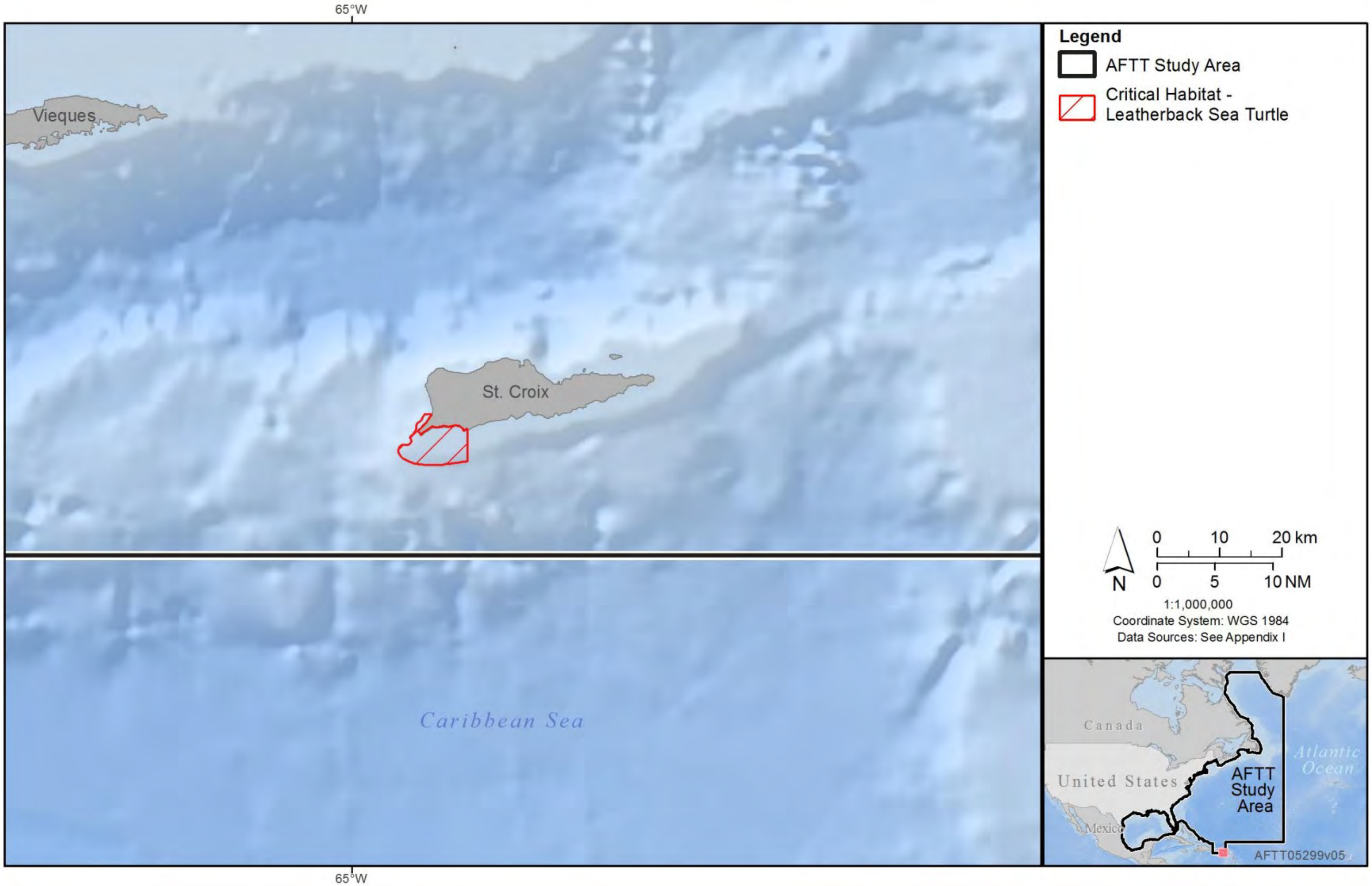
3.8.2.2.5.2 Habitat and Geographic Range

The leatherback turtle is distributed worldwide in tropical and temperate waters of the Atlantic, Pacific, and Indian Oceans. (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2013b).

Important nesting areas in the western Atlantic Ocean occur in Florida, St. Croix, Puerto Rico, Costa Rica, Panama, Colombia, Trinidad and Tobago, Guyana, Suriname, French Guiana, and southern Brazil (Brautigam & Eckert, 2006; Márquez, 1990; Spotila et al., 1996). Other minor nesting beaches are scattered throughout the Caribbean, Brazil, and Venezuela (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2013b). Leatherback nesting season begins and ends a few months earlier than that of the other sea turtle species that nest in the Study Area, beginning in March in the more northern nesting habitats (e.g., Florida) and continues in more southern nesting habitats (e.g., Puerto Rico). Females remain in the general vicinity of the nesting habitat between nestings, with total residence in the nesting and inter-nesting habitat lasting up to four months. Horrocks et al. (2016) tagged over 3,100 female leatherbacks in the Caribbean Sea and found that females traveled an average of 160 km between nesting events within the same season. Migrations between nesting seasons were typically to the north towards more temperate latitudes, which support high densities of jellyfish prey in the summer.

In the Atlantic Ocean, equatorial waters appear to be a barrier between breeding populations. In the northwestern Atlantic Ocean, post-nesting female migrations appear to be restricted to north of the equator, but the migration routes vary (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2013b). Leatherbacks made round-trip migrations from where they started through the North Atlantic Ocean heading northwest to fertile foraging areas off the Gulf of Maine, Canada, and Gulf of Mexico; others crossed the ocean to areas off Western Europe and Africa; while others spent time between northern and equatorial waters. These data support earlier studies that found adults and subadults captured in waters off Nova Scotia stayed in waters north of the Equator (James et al., 2005a; James et al., 2005b; James et al., 2006).

Limited information is available on the habitats used by post-hatchling and early juvenile leatherback sea turtles because these age classes are entirely oceanic (National Marine Fisheries Service and U.S. Fish and Wildlife Service, 1992). These life stages are restricted to waters warmer than 79°F (26°C); consequently, much time is spent in the tropics (Eckert, 2002). They are not considered to associate with *Sargassum* or other flotsam, as is the case for all other sea turtle species (Horrocks, 1987; Johnson, 1989). Upwelling areas, such as equatorial convergence zones, serve as nursery grounds for post-hatchling and early juvenile leatherback sea turtles because these areas provide a high biomass of prey (Musick & Limpus, 1997).



Note: AFTT: Atlantic Fleet Training and Testing

Figure 3.8-9: Critical Habitat Designation for the Leatherback Sea Turtle within the Study Area

Late juvenile and adult leatherback sea turtles are known to range from mid-ocean to the continental shelf and nearshore waters (Barco & Lockhart, 2015; Grant & Ferrell, 1993; Schroeder & Thompson, 1987; Shoop & Kenney, 1992). Although leatherbacks were observed annually in Chesapeake Bay, they were not common and unevenly distributed. Juvenile and adult foraging habitats include both coastal and offshore feeding areas in temperate waters and offshore feeding areas in tropical waters. Leatherbacks have been shown to travel shorter distances at slower rates and increased diving rates in areas of high prey abundance, which is related to seasonal availability of prey (Wallace et al., 2015). Leatherback sea turtles mate in waters adjacent to nesting beaches and along migratory corridors (Cummings et al., 2016; Figgener et al., 2016).

3.8.2.2.5.3 Population Trends

Population trends for leatherback turtles in Florida show increases, with leatherback populations north of Florida being a stable population (National Marine Fisheries Service, 2013b; Stewart et al., 2014). This increase has coincided with an upsurge in the Caribbean population. Sporadic nesting also occurs in Georgia, South Carolina, as far north as North Carolina (National Marine Fisheries Service and U.S. Fish and Wildlife Service, 1992; Rabon et al., 2003; Schwartz, 1989), and in the Gulf of Mexico on the Florida panhandle. One of the most globally important stocks of leatherback turtles, the Southern Caribbean Stock, nests in French Guiana, Guyana, Suriname, and Trinidad but migrates and forages throughout the North Atlantic. The Western Caribbean stock of the Central American coast also migrates through the Study Area en route to North Atlantic foraging grounds. Nesting populations in southern Florida, Culebra, Puerto Rico, and the U.S. Virgin Islands are believed to be increasing due to heightened protection and monitoring of the nesting habitat over the past 30 years (National Marine Fisheries Service, 2011; National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2013b; Turtle Expert Working Group, 2007).

The Florida nesting stock comes ashore primarily along the east coast of Florida. In the 1980s, fewer than 100 nests per year were reported. Based on data extrapolated from the index nesting beach surveys, nesting activity has shown an annual growth rate of 1 percent between 1989 and 2005 (National Marine Fisheries Service, 2013b). Larger growth rates (10.2 percent increases per year) in nesting activity in this area have been shown from 68 Florida beaches since 1979 (Stewart et al., 2011; Stewart et al., 2014). Florida statewide nesting reports show nesting numbers fluctuating between 896 nests and 1,712 nests during a five-year period between 2011 and 2015. Surveyors counted 205 leatherback nests on the 27 core index beaches in 2017 in Florida, which represents the lowest number of nests reported since 2006. While green turtle nest numbers on Florida's index beaches continue to rise, leatherback nest numbers have been declining since 2014 (Florida Fish and Wildlife Conservation Commission, 2017).

3.8.2.2.5.4 Predator and Prey Interactions

Leatherbacks lack the crushing chewing plates characteristic of hard-shelled sea turtles that feed on hard-bodied prey. Instead, they have pointed tooth-like cusps and sharp-edged jaws that are adapted for a diet of soft-bodied open-ocean prey such as jellyfish and salps. Leatherback sea turtles feed throughout the water column (Davenport, 1988; Eckert et al., 1989; Eisenberg & Frazier, 1983; Grant & Ferrell, 1993; James et al., 2005b; James et al., 2005c; Salmon et al., 2004). Leatherback prey is predominantly jellyfish (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2013b; Wallace et al., 2015).In Atlantic Canada, leatherbacks feed on jellyfish of *Cyanea* spp. and *Aurelia* spp. (James & Herman, 2001; Votier et al., 2011). In North Carolina and Georgia, turtles feed on cannonball jellies (*Stomolophus meleagris*) (Frick et al., 1999; Grant & Ferrell, 1993). Patterns in feeding behavior off St. Croix, U.S. Virgin Islands, over a 24-hour period suggest an interaction between leatherback diving and vertical movements of the deep scattering layer (a horizontal zone of planktonic organisms), with more frequent and shallower dives at night compared with fewer and deeper day dives (Eckert et al., 1989). Research in the feeding grounds of Georgia (Frick et al., 1999), North Carolina (Grant & Ferrell, 1993), and Atlantic Canada (James & Herman, 2001) has documented leatherbacks foraging on jellyfish at the surface.

Predators of leatherback nests are common to other sea turtle species (e.g., terrestrial mammals and invertebrates). Burns et al. (2016) found that nesting female leatherbacks expend a significant amount of time and energy, despite increased risk of direct predation while on land, to obscure nests. After laying nests and covering with sand, the female's return to the ocean is not linear, and is likely an attempt at decoy behavior as a further measure to protect the clutch. In the water, hatchlings are susceptible to predation by birds and fish. Sharks are the primary predator of juvenile and adult leatherback sea turtles (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2013b).

3.8.2.2.5.5 Species-Specific Threats

In addition to the general threats to sea turtles described previously, bycatch in commercial fisheries is a particular threat to leatherback sea turtles. Incidental capture in longline and coastal gillnet fisheries has caused a substantial number of leatherback sea turtle deaths, likely because leatherback sea turtles dive to depths targeted by longline fishermen and are less maneuverable than other sea turtle species. Shrimp trawls in the Gulf of Mexico have been estimated to capture about 3,000 leatherback sea turtles, with 80 of those sea turtles dying as a result (Finkbeiner et al., 2011; Wallace et al., 2010b). Along the Atlantic coast of the United States, NMFS estimated that about 800 leatherback sea turtles are captured in pelagic longline fisheries, bottom longline, and drift gillnet fisheries for sharks as well as lobster, deep-sea red crab, Jonah crab, dolphin fish and wahoo, and Pamlico Sound gillnet fisheries. Although most of these turtles are released alive, these fisheries kill about 300 leatherback sea turtles each year (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2013b; Stewart et al., 2016). Harvest of leatherback sea turtle eggs and adult turtles continues to be a threat in many parts of the world (Humber et al., 2014). Lastly, climate change may impact leatherbacks in ways different from other sea turtle species because their distribution is so closely associated with jellyfish aggregations (which are affected by changing ocean temperatures and dynamics) (Pike, 2014). Robinson et al. (2013) suggest that climate change impacts are contributing to the Pacific leatherback population declines through a shifting of nesting dates to increase stressor exposure. The observed mean nesting date shifts in the Atlantic leatherback genetic stocks, in contrast to Pacific populations, may increase resiliency of Atlantic leatherbacks to climate-related impacts.

3.8.2.2.6 American Crocodile (*Crocodylus acutus*)

3.8.2.2.6.1 Status and Management

The American crocodile occurs within the jurisdictional boundaries of many different countries and is distributed in primarily coastal waters throughout the Caribbean Sea and on the Pacific coast of Central and South America from Mexico to Ecuador (Thorbjarnarson et al., 2006). Population declines have been attributed to loss of habitat and extensive poaching for their hides (U.S. Fish and Wildlife Service, 2010). The Florida population marks the northern extent of this species' range and is classified as a distinct population segment due to its genetic isolation (U.S. Fish and Wildlife Service, 2010). The American crocodile was listed as endangered under the ESA throughout its range in 1979 (44 *Federal Register*

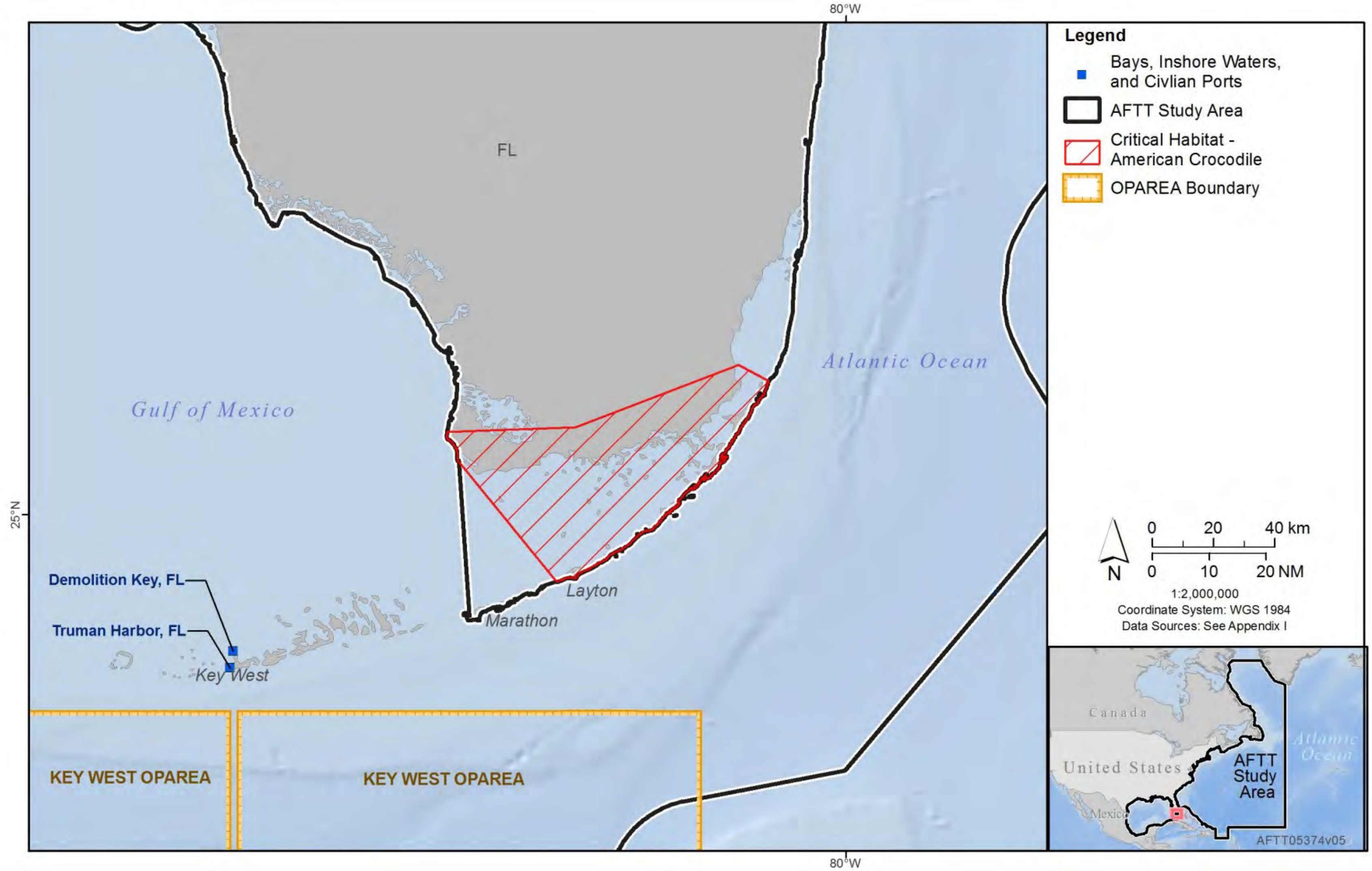
17710). In 2007, the Florida population of American crocodiles was reclassified as a distinct population segment and was designated as threatened under the ESA; the population outside of Florida remains listed as endangered under the ESA. Critical habitat was designated for the Florida population in 1976 and was slightly modified in 1977 to include a more accurate map of the habitat (41 *Federal Register* 41914, 44 *Federal Register* 75074) (Figure 3.8-10). The essential physical and biological feature of this critical habitat is Florida Bay and its associated brackish marshes, swamps, creeks, and canals because the crocodile population is concentrated in these waters, and all known breeding females inhabit and nest here (41 *Federal Register* 41914).

3.8.2.2.6.2 Habitat and Geographic Range

The American crocodile is typically found in fresh or brackish coastal habitats, including, but not limited to rivers, ponds, lagoons, and mangrove swamps (Mazzotti et al., 2007; Mazzotti, 2014; Wheatley et al., 2012). American crocodiles generally occur in water with salinities less than 20 parts per thousand; however, they possess salt lingual glands allowing them to excrete excess salt (Cherkiss et al., 2014; Wheatley et al., 2012) and occasionally inhabit more saline environments (e.g., Florida Bay) (Wheatley et al., 2012). Most crocodile sightings in more saline water are females attending nest sites, hatchlings at nest sites, or juveniles presumably avoiding adults (Mazzotti et al., 2007). Females construct nests on elevated, well-drained sites near the water such as ditch banks and beaches. In the United States, artificial nesting sites within berms along canal banks provide nearly ideal nesting conditions because they are elevated, well drained, and near relatively deep, low-to-intermediate salinity water (Mazzotti et al., 2007). These artificial nesting habitats appear to be compensating for natural habitat elsewhere in Florida and account for much of the increase in nesting documented since 1975.

The American crocodile is known to inhabit inshore marine waters and is not predisposed to travel across the open ocean (Cherkiss et al., 2014). Instead, they prefer calm warm waters with minimal wave action, and most frequently occur in sheltered, mangrove-lined estuaries (Mazzotti, 1983). No available evidence suggests that crocodiles cross the Florida Straits; therefore, this species is not expected to occur in offshore areas within the Study Area. The American crocodile, however, can travel long distances in nearshore environments. For example, Cherkiss et al. (2014) tracked an individual American crocodile over a 14-year period. The crocodile was originally marked in Homestead, Florida, as a young-of-the-year in 1999, and was later recaptured multiple times more than 388 km away along the southwest coast of Florida. After several relocations and numerous sightings, this individual returned the same canal system in which it was first captured.

Within the United States, distribution is limited to the southern tip of mainland Florida and the Florida Keys, which represents the northern extent of its range. The American crocodile range appears to be expanding (Mazzotti et al., 2007) (70 *Federal Register* 15052). Regular nesting occurs within Biscayne Bay on Florida's east coast, on the border between the Southeast U.S. Continental Shelf and Gulf of Mexico Large Marine Ecosystems, and there is evidence that the species is expanding its current range to occupy portions of its historic range within the Florida Keys (Mazzotti et al., 2007). Most nesting occurs in the Everglades National Park, the cooling water discharge canal of the Turkey Point Power Plant (Homestead, Florida), and Crocodile Lake National Wildlife Refuge in the Gulf of Mexico Large Marine Ecosystem (Mazzotti et al., 2007). Currently, few crocodiles are found north of Biscayne Bay on the Atlantic Coast of Florida, or north of Sanibel Island on Florida's gulf coast. However, sightings have occurred in the coastal counties of mainland Florida from as far north as Indian River County on the Atlantic coast and Sarasota County on the Gulf coast (72 *Federal Register* 13027) and Lee County on the west coast (Green et al., 2014; U.S. Fish and Wildlife Service, 2010; Wheatley et al., 2012).



Notes: AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area

Figure 3.8-10: Critical Habitat Designation for the American Crocodile within the Study Area

3.8.2.2.6.3 Population Trends

In 1976, the American crocodile population in Florida was estimated to be between 200 and 300 individuals (40 *Federal Register* 58308), with only 10–20 breeding females estimated in 1975 (40 *Federal Register* 58308). An estimated 20 nests were laid in Florida in 1975. As a result of conservation measures, including habitat protection, the number of nests increased to 85 in 2004 (Mazzotti et al., 2007). The most recent population estimate, provided by the Florida Fish and Wildlife Commission, estimates the current Florida population of crocodiles to range between 1,500 and 2,000 adults, with an estimated 100 nests per year occurring in Florida (Florida Fish and Wildlife Conservation Commission, n.d.). The species is gradually recovering in the United States, but survey data from Central and South America are relatively poor. The Florida population of the American crocodile has increased, and its distribution has expanded, since it was listed as endangered.

Increased sightings of crocodiles on the airfield at the Naval Air Station Key West has initiated interest in having surveys for crocodiles performed on station. The Navy is currently monitoring occurrences of American crocodiles at Naval Air Station Key West. In 2014, 21 American crocodiles (along with one American alligator and two indistinguishable eye shines) were identified at the air station. Nesting may also occur on the coastal portions of the air station (Mazzotti, 2014). During 2016 spotlight surveys (occurring in January, April, June, and August), a total of seven crocodiles and one alligator were observed at Naval Air Station Key West. No nesting activity was observed on the Naval Air Station Key West properties.

3.8.2.2.6.4 Predator and Prey Interactions

The American crocodile typically forages from shortly before sunset to shortly after sunrise (U.S. Fish and Wildlife Service, 2010). During these times, crocodiles feed on any prey items that can be caught and overpowered (Mazzotti et al., 2007). Adults feed on fish, crabs, birds, turtles, snakes, and small mammals, while young feed on aquatic invertebrates and small fish.

Fire ants are predators of crocodile eggs. Crocodile hatchlings may be preyed on by large fish, birds, other large reptiles and amphibians, or even other crocodiles. Larger juvenile and adult crocodiles have no known natural predators (Mazzotti et al., 2007).

3.8.2.2.6.5 Species-Specific Threats

Habitat loss is a primary threat to the American crocodile (U.S. Fish and Wildlife Service, 2010). Development in coastal areas of Florida diminishes American crocodile habitat and restricts the species' breeding range. Erosion or sea level rise may further increase vulnerability of nesting sites. In addition to direct habitat loss, alteration of habitat is a concern. Urban and residential development restricts freshwater flow into swamps and estuaries, which may limit crocodile growth, survival, and abundance (Mazzotti et al., 2007). Collisions with automobiles are also a documented cause of mortality in Florida's southernmost Miami-Dade and Monroe Counties (Mazzotti et al., 2007). Cold weather has also been cited as a primary constraint on American crocodile recovery and expansion into suitable habitats within this species' historic range. For example, a 2010 freeze in south Florida resulted in a mass die off of reptiles and fish, including more than 150 American crocodiles (Mazzotti et al., 2016).

The introduction in Florida of Nile crocodiles (*Crocodulus niloticus*), confirmed recently through genetic analyses, presents threats to the American crocodile (Rochford et al., 2016). As a competitor for prey and habitat, the Nile crocodile can also likely predate smaller American crocodiles. In addition, many crocodilian species are already known to hybridize in captivity and where their native ranges overlap in the wild (e.g., Cuban crocodile [*Crocodulus rhombifer*]), which can degrade the genetic integrity of the American crocodile (Weaver et al., 2008). Because of similarity of appearance, Nile crocodile persecution by humans would likely include accidental poaching of American crocodiles (Rochford et al., 2016). Burmese pythons, as discussed previously in Section 3.8.2.1.5.4 (Invasive Species), may prey upon juvenile and small adult crocodiles and compete for crocodile prey base. Hart et al. (2012) have shown salt water tolerance in newly hatched pythons, which may increase the predation risk of American crocodiles and increase competition for crocodile prey base.

3.8.2.2.7 American Alligator (*Alligator mississippiensis*)

3.8.2.2.7.1 Status and Management

American alligator populations began to decline in the late 1800s, when unregulated hunting for the hides became prevalent, with population numbers close to extinction in some areas (Savannah River Ecology Laboratory & Herpetology Program, 2012). A hunting ban in the 1950s and other recovery efforts allowed the species to rebound (52 *Federal Register* 21059). American alligators were listed as an endangered species in 1967 under a law that preceded the ESA of 1973 (National Park Service, 2012). No critical habitat has been designated for this species. Federal legislation in the 1970s and 1980s, including the ESA and amendments to the Lacey Act in 1981, ensured the alligators' protection, and eventually their comeback. In 1987, the alligator was declared "no longer biologically threatened or endangered" (52 *Federal Register* 21059). However, to ensure protections to the American crocodile and other endangered crocodilians, the American alligator is listed under the ESA classification of "threatened due to similarity of appearance" to the American crocodile (52 *Federal Register* 21059). Accordingly, federal agencies are no longer required to consult with USFWS pursuant to section 7 of the ESA. Hunting and trade of the American alligator are now permitted and regulated by USFWS (National Park Service, 2012; Savannah River Ecology Laboratory & Herpetology Program, 2012).

3.8.2.2.7.2 Habitat and Geographic Range

The American alligator resides along the southeastern coast of the United States from North Carolina south through Florida and westward to the Texas coast (Elsey & Woodward, 2010). The American alligator's primary habitats are freshwater swamps and marshes but may also include lakes, canals, ponds, reservoirs, and rivers. As alligators lack lingual salt glands, the species has a limited capacity to tolerate highly saline environments (Mazzotti & Dunson, 1989). In coastal areas, alligators move between freshwater and estuarine waters. Size and sex influences the habitat that alligators reside in; adult males generally prefer deep, open water within coastal water bodies, while adult females prefer coastal open water habitats only during the spring breeding season. After the breeding season, adult females prefer to move to lake and marsh edges during nesting and hatching seasons (Savannah River Ecology Laboratory & Herpetology Program, 2012). After juveniles have hatched, they remain with the female for up to a year or more for protection during this vulnerable life stage (National Park Service, 2012; Savannah River Ecology Laboratory & Herpetology Program, 2012). Smaller alligators prefer wetlands with dense vegetation for protection and prey advantage (Savannah River Ecology Laboratory & Herpetology Program, 2012).

3.8.2.2.7.3 Population and Abundance

Following state and federal management of this species, alligator populations have rebounded to an estimated total in the millions of individuals (Savannah River Ecology Laboratory & Herpetology Program, 2012). The Navy is currently monitoring occurrences of American alligators at Naval Air Station Key West. In 2014, one American alligator (along with 21 American crocodiles and two indistinguishable eye shines) was identified at the air station. During 2016 spotlight surveys (occurring in January, April, June, and August), one alligator was observed at Naval Air Station Key West. No nesting activity was observed on the Naval Air Station Key West properties. Nesting may also occur on the coastal portions of the air station (Mazzotti et al., 2016).

3.8.2.2.7.4 Predator and Prey Interactions

American alligators are opportunistic carnivores. Adults eat a variety of animals, including large fish, turtles, snakes, birds, and small mammals. Hatchlings and smaller alligators eat insects, crayfish, snails and other invertebrates, small fish, and amphibians (Savannah River Ecology Laboratory & Herpetology Program, 2012).

Alligator eggs are often preyed upon by raccoons, opossums, skunks, feral pigs, and other terrestrial nest predators. Similarly, young alligators are preyed upon by raccoons, crabs, large snakes, turtles, birds, and even fish (Savannah River Ecology Laboratory & Herpetology Program, 2012).

3.8.2.2.7.5 Species-Specific Threats

State-level management programs, including managed harvesting, have not appeared to impact alligator populations. Alligators, however, appear to be sensitive to water quality parameters (e.g., salinity, temperature, and contaminants such as heavy metals and pharmaceuticals), as well as prey availability (Hidalgo-Ruz et al., 2012).

3.8.2.3 Species Not Listed under the Endangered Species Act

3.8.2.3.1 Diamondback terrapin (*Malaclemys terrapin*)

3.8.2.3.1.1 Status and Management

The diamondback terrapin is a widely distributed species that is native to the brackish coastal tidal marshes of the eastern and southern United States. This includes the states of Alabama, Connecticut, Delaware, Florida, Georgia, Louisiana, Maryland, Massachusetts, Mississippi, New Jersey, New York, North Carolina, Rhode Island, South Carolina, Texas, and Virginia. Population declines of this species are typically local and due to crab trap mortality and vehicle strikes on land. Several states have laws/regulations requiring that crab pot traps be fitted with exclusion or escape mechanisms to prevent bycatch of terrapins. The diamondback terrapin is not ESA listed, but is state listed in Massachusetts as Threatened. All U.S. states within this species' range (except New York) have designated this species as a Species of Greatest Conservation Need (U.S. Fish and Wildlife Service, 2013).

3.8.2.3.1.2 Habitat and Geographic Range

Typical habitat of the diamondback terrapin includes coastal swamps, estuaries, lagoons, tidal creeks, mangroves, and salt marshes with salinities ranging from 0 to 35 parts per thousand. Diamondback terrapins have salt glands around their eyes, allowing them to secrete excess salt from their blood, and survive in salty environments (University of Georgia, 2017). Although diamondback terrapins are found in brackish water, periodic access to freshwater is required for long-term health. Diamondback terrapins play an important role in coastal saltwater marsh ecosystems by aiding in seed dispersal, controlling insect and snail populations, and contributing to other ecological services (e.g., removing suspended sediments and contaminants in water) through perpetuating eelgrass spread (Pfau & Roosenburg, 2010).

Although diamondback terrapins are an aquatic turtle and spend the majority of their life in water, they do leave the water to bask and lay eggs (University of Georgia, 2017). During the cold winter months, diamondbacks hibernate in the mud at the bottom of tidal creeks. Nesting females wander considerable distances on land before nesting. Nests are usually laid in sand dunes or scrub vegetation near the ocean. Eggs are typically laid in late May through August and generally take 50–80 days to hatch.

The distribution of diamondback terrapins is best described as discontinuous along the approximately 5,000 km of coastline between Cape Cod, Massachusetts, and Corpus Christi, Texas (Pfau & Roosenburg, 2010). Throughout this distribution, there are seven defined subspecies of the diamondback terrapin based primarily on differences in carapace morphology and skin coloring (Hart & Lee, 2006). The subspecies are listed below:

- Carolina diamondback terrapin (*Malaclemys terrapin centrata*)
- Texas diamondback terrapin (*Malaclemys terrapin littoralis*)
- Ornate diamondback terrapin (*Malaclemys terrapin macrospilota*)
- Mississippi diamondback terrapin (*Malaclemys terrapin pileata*)
- Mangrove diamondback terrapin (*Malaclemys terrapin rhizophorarum*)
- Eastern Florida diamondback terrapin (*Malaclemys terrapin tequesta*)
- Northern diamondback terrapin (*Malaclemys terrapin terrapin*)

Despite this extensive distribution, its zone of occurrence is very linear and in places fragmented, resulting in a relatively small total area of occupancy (Hart & Lee, 2006).

Population Trends

Terrapins have a long history of exploitation by humans, who harvested them for food for decades (University of Georgia, 2017). The current population size of diamondback terrapins in the United States is unknown, but estimated to be over 100,000 individuals. Most diamondback terrapin populations range from stable to declining.

3.8.2.3.1.4 Predator Prey Interactions

Diamondback terrapins feed on shrimp, clams, barnacles, crabs, mussels and other marine invertebrates. Juveniles prey on insects and small crustaceans. Most notably, adults feed on salt marsh periwinkle (*Littoraria irrorata*), a snail that feeds on salt marsh cord grass. By feeding on the periwinkles, the diamondback terrapins control the populations of periwinkles and prevent them from overgrazing cord grasses (U.S. Fish and Wildlife Service, 2013). Nests, hatchlings, and sometimes adults are eaten by raccoons, foxes, rats and many species of birds, especially crows and gulls, which significantly impacts juvenile population numbers.

3.8.2.3.1.5 Species-Specific Threats

The species has declined significantly from historic levels, in part due to 19th and 20th century harvesting as gourmet food. Harvesting of turtles and eggs is no longer a primary threat to this species. In the states of South Carolina and Maryland, there have been significant local declines due to crab trap mortality and vehicle (car and boat) strikes. Additionally, a decline in the population of females is consistent with the increased mortality of nesting females from vehicle strikes while searching for nesting sites on land (U.S. Fish and Wildlife Service, 2013). Additional threats include loss of nesting habitat (erosion, land subsidence and shoreline hardening, residential development), nest and hatchling predation, and water quality degradation.

3.8.3 Environmental Consequences

This section evaluates how, and to what degree, the activities described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions) potentially impact reptiles known to occur within the Study Area. Tables 2.6-1 through 2.6-4 present proposed typical training and testing activity locations for each alternative (including number of events). General characteristics of all U.S. Navy stressors were introduced in Section 3.0.3.3 (Identifying Stressors for Analysis), and living resources' general susceptibilities to stressors were introduced in Section 3.0.3.6 (Biological Resource Methods). The stressors vary in intensity, frequency, duration, and location within the Study Area. The stressors analyzed for reptiles are:

- **Acoustic** (sonar and other transducers; air guns; pile driving; vessel noise; aircraft noise; and weapon noise)
- **Explosive** (explosions in-air, explosions in-water)
- **Energy** (in-water electromagnetic devices; high-energy lasers
- **Physical disturbance and strikes** (vessels and in-water devices; military expended materials; seafloor devices; pile driving)
- **Entanglement** (wires and cables; decelerators/parachutes; biodegradable polymers)
- **Ingestion** (military expended materials – munitions; military expended materials other than munitions)
- **Secondary stressors** (impacts on habitat; impacts on prey availability)

The analysis includes consideration of the mitigation that the Navy will implement to avoid potential impacts on sea turtles from acoustic, explosive, and physical disturbance and strike stressors. Mitigation was coordinated with NMFS and the USFWS through the consultation process. Details of the Navy's mitigation are provided in Chapter 5 (Mitigation).

3.8.3.1 Acoustic Stressors

The analysis of effects to reptiles follows the concepts outlined in Section 3.0.3.6.1 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities). This section begins with a summary of relevant data regarding acoustic impacts on reptiles in Section 3.8.3.1.1 (Background). This is followed by an analysis of estimated impacts on reptiles due to specific Navy acoustic stressors (sonar and other transducers, air guns, pile driving, vessel noise, aircraft noise, and weapon noise). Additional explanations of the acoustic terms and sound energy concepts used in this section are found in Appendix D (Acoustic and Explosive Concepts). Studies of the effects of sound on aquatic reptiles are limited; therefore, where necessary, knowledge of impacts on other species from acoustic stressors is used to assess impacts on sea turtles, crocodilians, and terrapins.

3.8.3.1.1 Background

The sections below include a survey and synthesis of best-available-science published in peer-reviewed journals, technical reports, and other scientific sources pertinent to impacts on reptiles potentially resulting from Navy training and testing activities. Reptiles could be exposed to a range of impacts depending on the sound source and context of the exposure. Exposures to sound-producing activities may result in auditory or non-auditory trauma, hearing loss resulting in temporary or permanent hearing threshold shift, auditory masking, physiological stress, or changes in behavior.

3.8.3.1.1.1 Injury

The high peak pressures close to some non-explosive impulsive underwater sound sources, such as air guns and impact pile driving, may be injurious, although there are no reported instances of injury to reptiles caused by these sources. A Working Group organized under the American National Standards Institute-Accredited Standards Committee S3, Subcommittee 1, Animal Bioacoustics, developed sound exposure guidelines for fish and sea turtles (Popper et al., 2014), hereafter referred to as the *ANSI Sound Exposure Guidelines*. Lacking any data on non-auditory sea turtle injuries due to non-explosive impulsive sounds, such as air guns and impact pile driving, the working group conservatively recommended that non-auditory injury could be analyzed using data from fish. The data show that fish would be resilient to injury to the non-explosive impulsive sound sources analyzed in this EIS/OEIS. Therefore, it is assumed that sea turtles, crocodilians, and terrapins would be as well. Additionally, sea turtle shells may protect against non-auditory injury due to exposures to high peak pressures (Popper et al., 2014), which can also be assumed for terrapins.

Lacking any data on non-auditory sea turtle injuries due to sonars, the working group also estimated the risk to sea turtles from low-frequency sonar to be low and mid-frequency sonar to be non-existent. Due to similarity in hearing, it is assumed that this would be the case for crocodilians and terrapins, as well.

As discussed in Section 3.0.3.6.1 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities, specifically Section 3.0.3.6.1.1, Injury), mechanisms for non-auditory injury due to acoustic exposure have been hypothesized for diving breath-hold animals. Acoustically induced bubble formation, rectified diffusion, and acoustic resonance of air cavities are considered for their similarity to pathologies observed in marine mammals stranded coincident with sonar exposures but were found to not be likely causal mechanisms (Section 3.7.3.1.1.1, Injury), and findings are applicable to reptiles.

Nitrogen decompression due to modifications to dive behavior has never been observed in sea turtles. Sea turtles are thought to deal with nitrogen loads in their blood and other tissues, caused by gas exchange from the lungs under conditions of high ambient pressure during diving, through anatomical, behavioral, and physiological adaptations (Lutcavage & Lutz, 1997). Although diving sea turtles experience gas supersaturation, gas embolism has only been observed in sea turtles bycaught in fisheries (Garcia-Parraga et al., 2014). Therefore, nitrogen decompression due to changes in diving behavior is not considered a potential consequence to diving reptiles.

3.8.3.1.1.2 Hearing Loss and Auditory Injury

Exposure to intense sound may result in hearing loss, typically quantified as threshold shift, which persists after cessation of the noise exposure. Threshold shift is a loss of hearing sensitivity at an affected frequency of hearing. This noise-induced hearing loss may manifest as temporary threshold shift (TTS), if hearing thresholds recover over time, or permanent threshold shift (PTS), if hearing thresholds do not recover to pre-exposure thresholds. Because studies on inducing threshold shift in reptiles are very limited (e.g., alligator lizards; Dew et al., 1993; Henry & Mulroy, 1995), are not sufficient to estimate PTS and TTS onset thresholds, and have not been conducted on any of the reptiles present in the Study Area, auditory threshold shift in reptiles is considered to be consistent with general knowledge about noise-induced hearing loss described in Section 3.0.3.6.1 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities).

Because there are no data on auditory effects on sea turtles, the *ANSI Sound Exposure Guidelines* (Popper et al., 2014) do not include numeric sound exposure thresholds for auditory effects on sea turtles. Rather, the guidelines qualitatively estimate that sea turtles are less likely to incur TTS or PTS with increasing distance from various sound sources. The guidelines also suggest that data from fishes may be more relevant than data from marine mammals when estimating impacts on sea turtles, because, in general, fish hearing range is more similar to the limited hearing range of sea turtles. As shown in Section 3.8.2.1.4.1 (Hearing and Vocalization – Sea Turtles), sea turtle hearing is most sensitive around 100 to 400 Hz in-water, is limited over 1 kHz, and is much less sensitive than that of any marine mammal. Therefore, sound exposures from most mid-frequency and all high-frequency sound sources are not anticipated to affect sea turtle hearing, and sea turtles are likely only susceptible to auditory impacts when exposed to very high levels of sound within their limited hearing range.

Crocodilians and terrapins also have a limited hearing range, as described in Sections 3.8.2.1.4.2 (Hearing and Vocalization – Crocodilians) and 3.8.2.1.4.3 (Hearing and Vocalization – Terrapins), with best underwater hearing in the low frequencies, below 1 kHz, suitable for detecting low-frequency broadband vocalizations and sounds caused by prey movement. It is assumed that crocodilian and terrapin susceptibility to auditory impacts would be similar to that of sea turtles.

3.8.3.1.1.3 Physiological Stress

A stress response is a suite of physiological changes meant to help an organism mitigate the impact of a stressor. If the magnitude and duration of the stress response is too great or too long, then it can have negative consequences to the animal (e.g., decreased immune function, decreased reproduction). Physiological stress is typically analyzed by measuring stress hormones, other biochemical markers, or vital signs. Physiological stress has been measured for sea turtles or crocodilians during nesting (Flower et al., 2015; Valverde et al., 1999), capture and handling (Flower et al., 2015; Gregory & Schmid, 2001; Jessop et al., 2003; Lance et al., 2004), and when caught in entanglement nets (Hoopes et al., 2000; Snoddy et al., 2009) and trawls (Stabenau et al., 1991). However, the stress caused by acoustic exposure has not been studied for reptiles. Therefore, the stress response in reptiles in the Study Area due to acoustic exposures is considered to be consistent with general knowledge about physiological stress responses described in Section 3.0.3.6.1 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities).

Marine animals naturally experience stressors within their environment and as part of their life histories. Changing weather and ocean conditions, exposure to diseases and naturally occurring toxins, lack of prey availability, social interactions with members of the same species, nesting, and interactions with predators all contribute to stress. Anthropogenic sound-producing activities have the potential to provide additional stressors beyond those that naturally occur.

Due to the limited information about acoustically induced stress responses, the Navy conservatively assumes in its effects analysis that any physiological response (e.g., hearing loss or injury) or significant behavioral response is also associated with a stress response.

3.8.3.1.1.4 Masking

As described in Section 3.0.3.6.1 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities), auditory masking occurs when one sound, distinguished as the “noise,” interferes with the detection or recognition of another sound or limits the distance over which other biologically relevant sounds, including those produced by prey, predators, or conspecifics, can be detected. Masking only occurs when the sound source is operating; therefore, direct masking effects stop immediately upon cessation of the sound-producing activity. Any sound above ambient noise and within an animal’s hearing range may potentially cause masking.

Compared to other marine animals, such as marine mammals, that are highly adapted to use sound in the marine environment, marine reptile hearing is limited to lower frequencies and is less sensitive. Because marine reptiles likely use their hearing to detect broadband low-frequency sounds in their environment, the potential for masking would be limited to certain similar sound exposures. Only continuous human-generated sounds that have a significant low-frequency component, are not brief in duration, and are of sufficient received level could create a meaningful masking situation (e.g., vibratory pile extraction or proximate vessel noise). Other intermittent, short-duration sound sources with low-frequency components (e.g., air guns or low-frequency sonars) would have more limited potential for masking depending on duty cycle.

There is evidence that reptiles may rely primarily on senses other than hearing for interacting with their environment, such as vision (Narazaki et al., 2013), magnetic orientation (Avens, 2003; Putman et al., 2015b), and scent (Shine et al., 2004). Any effect of masking may be mediated by reliance on other environmental inputs.

3.8.3.1.1.5 Behavioral Reactions

Behavioral responses fall into two major categories: alterations in natural behavior patterns and avoidance. These types of reactions are not mutually exclusive and reactions may be combinations of behaviors or a sequence of behaviors. As described in Section 3.0.3.6.1 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities), the response of a reptile to an anthropogenic sound would likely depend on the frequency, duration, temporal pattern, and amplitude of the sound as well as the animal's prior experience with the sound and the context in which the sound is encountered (i.e., what the animal is doing at the time of the exposure). Distance from the sound source and whether it is perceived as approaching or moving away may also affect the way a reptile responds to a sound.

Reptiles may detect sources below 2 kHz but likely have limited hearing ability above 1 kHz. They likely detect most broadband sources (including air guns, pile driving, and vessel noise) and low-frequency sonars, so they may respond to these sources. Because auditory abilities for sea turtles and terrapins are poor above 1 kHz, detection and consequent reaction to any mid-frequency source is unlikely. Crocodilians have a slightly higher hearing range, but with best sensitivity around 800 Hz, they are assumed to have similar auditory abilities and reactions to sources below 2 kHz.

In the *ANSI Sound Exposure Guidelines* (Popper et al., 2014), qualitative risk factors were developed to assess the potential for sea turtles to respond to various underwater sound sources. The guidelines state that there is a low likelihood that sea turtles would respond within tens of meters of low-frequency sonars, and that it is highly unlikely that sea turtles would respond to mid-frequency sources. The risk that sea turtles would respond to other broadband sources, such as shipping, air guns, and pile driving, is considered high within tens of meters of the sound source, but moderate to low at farther distances. For this analysis, it is assumed that these guidelines would also apply to crocodilians and terrapins.

Behavioral Reactions to Impulsive Sound Sources

There are limited studies of reptile responses to sounds from impulsive sound sources, and all data come from sea turtles exposed to seismic air guns. These exposures consist of multiple air gun shots, either in close proximity or over long durations, so it is likely that observed responses may over-estimate responses to single or short-duration impulsive exposures. Studies of responses to air guns are used to inform reptile responses to other impulsive sounds (impact pile driving and some weapon noise).

O'Hara and Wilcox (1990) attempted to create a sound barrier at the end of a canal using seismic air guns. They reported that loggerhead turtles kept in a 300 m by 45 m enclosure in a 10 m deep canal maintained a minimum standoff range of 30 m from air guns fired simultaneously at intervals of 15 seconds, with strongest sound components within the 25–1,000 hertz frequency range. McCauley et al. (2000) estimated that the received sound pressure level (SPL) at which turtles avoided sound in the O'Hara and Wilcox (1990) experiment was 175–176 decibels referenced to 1 micropascal (dB re 1 µPa).

Moein Bartol et al. (1995) investigated the use of air guns to repel juvenile loggerhead sea turtles from hopper dredges. Sound frequencies of the air guns ranged from 100 to 1,000 Hz at three source SPLs: 175, 177, and 179 dB re 1 µPa. The turtles avoided the air guns during the initial exposures (mean range of 24 m), but additional exposures on the same day and several days afterward did not elicit avoidance behavior that was statistically significant. They concluded that this was likely due to habituation.

McCauley et al. (2000) exposed a caged green and a caged loggerhead sea turtle to an approaching-departing single air gun to gauge behavioral responses. The trials showed that above a received SPL of 166 dB re 1 µPa, the turtles noticeably increased their swimming activity compared to nonoperational periods, with swimming time increasing as air gun SPLs increased during approach. Above 175 dB re 1 µPa, behavior became more erratic, possibly indicating the turtles were in an agitated state. The authors noted that the point at which the turtles showed more erratic behavior and exhibited possible agitation would be expected to approximate the point at which active avoidance to air guns would occur for unrestrained turtles.

No obvious avoidance reactions by free-ranging sea turtles, such as swimming away, were observed during a multi-month seismic survey using air gun arrays, although fewer sea turtles were observed when the seismic air guns were active than when they were inactive (Weir, 2007). The author noted that sea state and the time of day affected both air gun operations and sea turtle surface basking behavior, making it difficult to draw conclusions from the data. However, DeRuiter and Doukara (2012) noted several possible startle or avoidance reactions to a seismic air gun array in the Mediterranean by loggerhead turtles that had been motionlessly basking at the water surface.

Behavioral Reactions to Sonar and Other Transducers

Studies of reptile responses to underwater non-impulsive sounds are limited. All data are from studies with sea turtles. Lenhardt (1994) used very low-frequency vibrations (< 100 Hz) coupled to a shallow tank to elicit swimming behavior responses by two loggerhead sea turtles. Watwood et al. (2016) tagged green sea turtles with acoustic transponders and monitored them using acoustic telemetry arrays in Port Canaveral, Florida. Sea turtles were monitored before, during, and after a routine pier-side submarine sonar test that utilized typical source levels, signals, and duty cycle. No significant long-term displacement was demonstrated by the sea turtles in this study. The authors note that Port Canaveral is an urban marine habitat and that resident sea turtles may be less likely to respond than naïve populations.

3.8.3.1.1.6 Long-Term Consequences

For the reptiles present in the Study Area, long-term consequences to individuals and populations due to acoustic exposures have not been studied. Therefore, long-term consequences to reptiles due to acoustic exposures are considered following Section 3.0.3.6.1 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities).

The long-term consequences due to individual behavioral reactions and short-term (seconds to minutes) instances of physiological stress are especially difficult to predict because individual experience over time can create complex contingencies. It is more likely that any long-term consequences to an individual would be a result of costs accumulated over a season, year, or life stage due to multiple behavioral or stress responses resulting from exposures to multiple stressors over significant periods of time. Conversely, some reptiles may habituate to or become tolerant of repeated acoustic exposures over time, learning to ignore a stimulus that in the past did not accompany any overt threat. For example, loggerhead sea turtles exposed to air guns with a source SPL of 179 dB re 1 µPa initially exhibited avoidance reactions. However, they may have habituated to the sound source after multiple exposures since a habituation behavior was retained when exposures were separated by several days (Moein Bartol et al., 1995). Intermittent exposures are assumed to be less likely to have lasting consequences.

3.8.3.1.2 Impacts from Sonar and Other Transducers

Sonar and other transducers emit sound waves into the water to detect objects, safely navigate, and communicate. Use of sonar and other transducers would typically be transient and temporary. General categories of sonar systems are described in Section 3.0.3.3.1 (Acoustic Stressors); only those sources within the hearing range of reptiles (<2 kHz) in the Study Area are considered.

Sonar-induced acoustic resonance and bubble formation phenomena are very unlikely to occur under realistic conditions, as discussed in Section 3.8.3.1.1.1 (Injury). Non-auditory injury (i.e., other than PTS) and mortality from sonar and other transducers is so unlikely as to be discountable under normal conditions and is therefore not considered further in this analysis.

The most probable impacts from exposure to sonar and other transducers are PTS, TTS, behavioral reactions, masking, and physiological stress (Sections 3.8.3.1.1.2, Hearing Loss and Auditory Injury; 3.8.3.1.1.3, Physiological Stress; 3.8.3.1.1.4, Masking; and 3.8.3.1.1.5, Behavioral Reactions).

Activities involving sonar and other transducers would not occur in areas inhabited by the ESA-listed American crocodile, thus potential impacts are limited to sea turtles, alligators, and terrapins.

3.8.3.1.2.1 Methods for Analyzing Impacts from Sonar and Other Transducers

Potential impacts considered are hearing loss due to threshold shift (permanent or temporary), masking of other biologically relevant sounds, physiological stress, and changes in behavior. The Navy performed a quantitative analysis to estimate the number of times that sea turtles could be affected by sonar and other transducers used during Navy training and testing activities. The Navy's quantitative analysis to determine impacts to sea turtles and marine mammals uses the Navy Acoustic Effects Model to produce initial estimates of the number of animals that may experience these effects; these estimates are further refined by considering animal avoidance of sound-producing activities and implementation of mitigation. The steps of this quantitative analysis are described in Section 3.0.1.2 (Navy's Quantitative Analysis to Determine Impacts to Sea Turtles and Marine Mammals), which takes into account:

- criteria and thresholds used to predict impacts from sonar and other transducers (see below);
- the density and spatial distribution of sea turtles; and
- the influence of environmental parameters (e.g., temperature, depth, salinity) on sound propagation when estimating the received sound level on the animals.

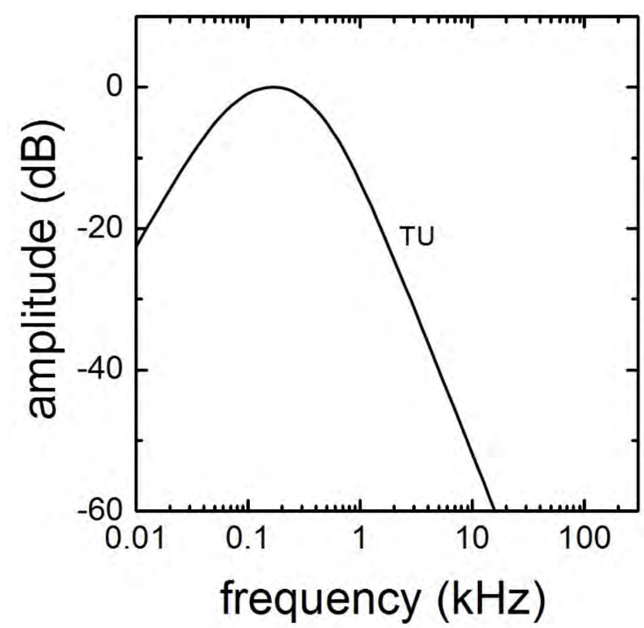
A further detailed explanation of this analysis is provided in the technical report titled *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing (U.S. Department of the Navy, 2018).* Since crocodilians and terrapins have similar hearing range and sensitivity as sea turtles, as described in Section 3.8.2.1.4 (Hearing and Vocalization), it is inferred that crocodilians and terrapins would react similarly to sonar and other transducers as sea turtles.

Criteria and Thresholds Used to Predict Impacts from Sonar and Other Transducers

Auditory Weighting Functions

Animals are not equally sensitive to noise at all frequencies. To capture the frequency-dependent nature of the effects of noise, auditory weighting functions are used. Auditory weighting functions are mathematical functions that adjust received sound levels to emphasize ranges of best hearing and de-emphasize ranges with less or no auditory sensitivity. The adjusted received sound level is referred to as a weighted received sound level.

The auditory weighting function for sea turtles is shown in Figure 3.8-11. The derivation of this weighting function is described in the technical report *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (U.S. Department of the Navy, 2017). The frequencies around the top portion of the function, where the amplitude is closest to zero, are emphasized, while the frequencies below and above this range (where amplitude declines) are de-emphasized, when summing acoustic energy received by a sea turtle.



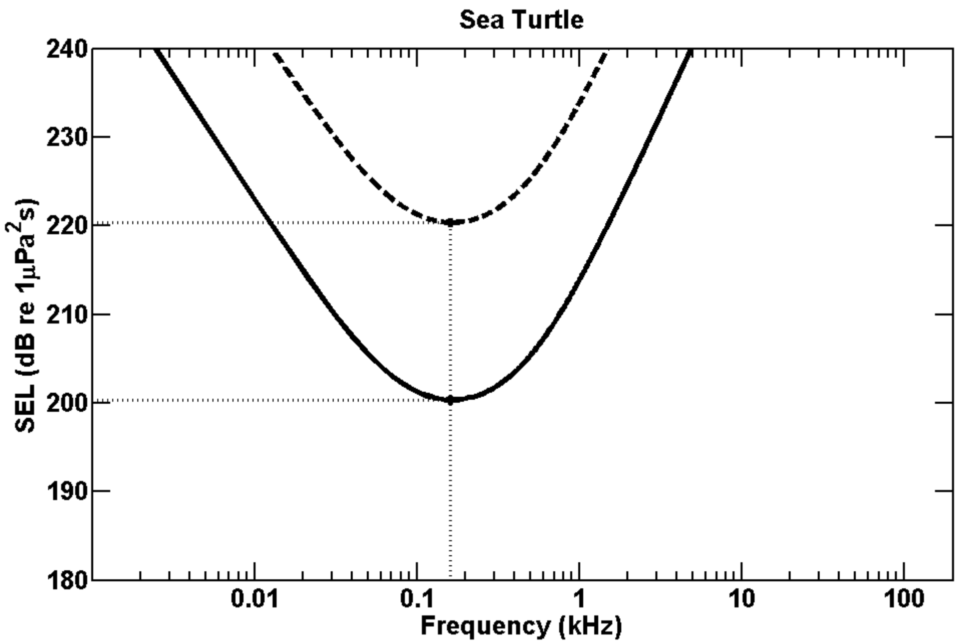
Source: U.S. Department of the Navy (2017)
Notes: dB: decibels; kHz: kilohertz; TU: sea turtle species group

Figure 3.8-11: Auditory Weighting Function for Sea Turtles

Hearing Loss from Sonar and Other Transducers

No studies of hearing loss have been conducted on sea turtles. Therefore, sea turtle susceptibility to hearing loss due to an acoustic exposure is evaluated using knowledge about sea turtle hearing abilities in combination with non-impulsive auditory effect data from other species (marine mammals and fish).

This yields sea turtle exposure functions, shown in Figure 3.8-12, which are mathematical functions that relate the sound exposure levels (SELs) for onset of PTS or TTS to the frequency of the sonar sound exposure. The derivation of the sea turtle exposure functions are provided in the technical report *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (U.S. Department of the Navy, 2017).



Source: U.S. Department of the Navy (2017)
Note: dB re 1 μPa²s: decibels referenced to 1 micropascal second squared; kHz: kilohertz. The solid black curve is the exposure function for TTS and the dashed black curve is the exposure function for PTS onset. Small dashed lines and asterisks indicate the SEL thresholds at the most-sensitive frequency for TTS (200 dB) and PTS (220 dB).

Figure 3.8-12: TTS and PTS Exposure Functions for Sonar and Other Transducers

Accounting for Mitigation

The Navy implements mitigation measures (described in Chapter 5, Mitigation) that would reduce the probability or severity of any potential impacts during activities that use sonar and other transducers, including the power-down or shut-down (i.e., power-off) of sonar when a sea turtle is observed in the mitigation zone. The mitigation zones for active sonar activities were designed to avoid the potential for sea turtles to be exposed to levels of sound that could result in auditory injury (i.e., PTS) from active sonar to the maximum extent practicable. The mitigation zones encompass the estimated ranges to injury (including PTS) for a given sonar exposure. Therefore, the impact analysis quantifies the potential for mitigation to reduce the risk of PTS. Two factors are considered when quantifying the effectiveness of mitigation: (1) the extent to which the type of mitigation proposed for a sound-producing activity (e.g., active sonar) allows for observation of the mitigation zone prior to and during the activity; and (2) the sightability of each species that may be present in the mitigation zone, which is determined by species-specific characteristics and the viewing platform. A detailed explanation of the analysis is provided in the technical report *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2018).

In the quantitative analysis, consideration of mitigation measures means that, for activities where mitigation is feasible, some model-estimated PTS is considered mitigated to the level of TTS. The impact analysis does not analyze the potential for mitigation to reduce TTS or behavioral effects, even though mitigation could also reduce the likelihood of these effects. In practice, mitigation also protects all unobserved (below the surface) animals in the vicinity, including other species, in addition to the observed animal. However, the analysis assumes that only animals sighted at the water surface would be protected by the applied mitigation. The analysis, therefore, does not capture the protection afforded to all marine species that may be near or within the mitigation zone.

The ability to observe the range to PTS was estimated for each training or testing event. The ability of Navy Lookouts to detect sea turtles in or approaching the mitigation zone is dependent on the animal's presence at the surface and the characteristics of the animal that influence its sightability (such as size or surface active behavior). The behaviors and characteristics of some species may make them easier to detect. Environmental conditions under which the training or testing activity could take place are also considered such as the sea surface conditions, weather (e.g., fog or rain), and day versus night.

3.8.3.1.2.2 Impact Ranges for Sonar and Other Transducers

Because sea turtle hearing range is limited to a narrow range of frequencies and thresholds for auditory impacts are relatively high, there are very few sonar sources that could potentially result in exposures exceeding the sea turtle PTS and TTS thresholds. Therefore, the range to auditory effects for most sources, such as the representative bin of LF5, in sea turtle hearing range is zero. Ranges would be greater (i.e., up to tens of meters) for sonars and other transducers with higher source levels; however, specific ranges cannot be provided in an unclassified document.

Ranges to auditory effects are not calculated for crocodilians or terrapins. Due to similarity in hearing and for purposes of this analysis, crocodilians and terrapins are assumed to have similar ranges to auditory impacts as sea turtles.

Presentation of Estimated Impacts from the Quantitative Analysis

The results of the analysis of potential impacts to sea turtles from sonars and other transducers are discussed below in Sections 3.8.3.1.2.3 (Impacts from Sonar and Other Transducers under Alternative 1) and 3.8.3.1.2.4 (Impacts from Sonar and Other Active Sources under Alternative 2). The detailed analysis of potential impacts estimated for individual species from exposure to sonar for training and testing activities under Alternative 1 and Alternative 2 are presented in the figures below. The figures below provide the estimated impacts per region, per activity, and by effect (e.g., TTS and PTS). There is a potential for impacts to occur anywhere within the Study Area where sound from sonar and the species overlap, although only Regions or Activity Categories where 0.5 percent of the impacts or greater are estimated to occur are graphically represented on the figures below. All (i.e., grand total) estimated impacts for that species are included in the bar plots, regardless of region or category.

Note that the numbers of activities planned can vary from year-to-year. Results are presented for a "maximum sonar use year". The number of hours these sonars would be operated are described in Section 3.0.3.3.1 (Acoustic Stressors). Potential impacts to crocodilians and terrapins are analyzed qualitatively.

3.8.3.1.2.3 Impacts from Sonar and Other Transducers under Alternative 1

Impacts from Sonar and Other Transducers under Alternative 1 for Training Activities

General categories and characteristics of sonar systems and the number of hours these sonars would be operated during training under Alternative 1 are described in Section 3.0.3.3.1 (Acoustic Stressors). Activities using sonars and other transducers would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). Use of sonar and other transducers would typically be transient and temporary.

Under Alternative 1, the number of major training exercises and civilian port defense activities would fluctuate each year to account for the natural variation of training cycles and deployment schedules. Some unit-level anti-submarine warfare training requirements would be met through synthetic training in conjunction with other training exercises. Training activities using low-frequency sonar and other transducers within reptile hearing range (<2 kHz) could occur throughout the Study Area in areas potentially inhabited by sea turtles, alligators, and terrapins, although use would generally occur within Navy range complexes, on Navy testing ranges, or around inshore locations identified in Chapter 2 (Description of Proposed Action and Alternatives). Use of low-frequency sonars during training activities would be greatest in the Jacksonville Range Complex and Chesapeake Bay.

The quantitative analysis, using the number of hours of sonar and other transducers for a maximum year of training activities under Alternative 1, predicts that no sea turtles of any species are likely to be exposed to the high received levels of sound from sonars or other transducers that could cause TTS or PTS. Only a limited number of sonars and other transducers with frequencies within the range of reptile hearing (<2 kHz) and high source levels have the potential to cause TTS and PTS.

The *ANSI Sound Exposure Guidelines* estimate the risk of a sea turtle responding to a low-frequency sonar (less than 1 kHz) is low regardless of proximity to the source, and there is no risk of a sea turtle responding to a mid-frequency sonar (1–10 kHz) (Popper et al., 2014). A reptile could respond to sounds detected within its limited hearing range if it is close enough to the source. The few studies of sea turtle reactions to sounds, discussed in Section 3.8.3.1.1.5 (Behavioral Reactions), suggest that a behavioral response could consist of temporary avoidance, increased swim speed, or changes in depth, or that there may be no observable response. Use of sonar and other transducers would typically be transient and temporary, and there is no evidence to suggest that any behavioral response would persist after a sound exposure. It is assumed that a stress response could accompany any behavioral responses.

Implementation of mitigation may further reduce the already low risk of auditory impacts on sea turtles. Depending on the sonar source, mitigation includes powering down the sonar or ceasing active sonar transmission if a sea turtle is observed in the mitigation zone, as discussed in Section 5.3.2 (Acoustic Stressors).

Although masking of biologically relevant sounds by the limited number of sonars and other transducers operated in reptile hearing range is possible, this may only occur in certain circumstances. Reptiles most likely use sound to detect nearby broadband, continuous environmental sounds, such as the sounds of waves crashing on the beach. The use characteristics of most low-frequency sonars, including limited band width, beam directionality, limited beam width, relatively low source levels, low duty cycle, and limited duration of use, would both greatly limit the potential for a reptile to detect these sources and limit the potential for masking of broadband, continuous environmental sounds. In addition, broadband sources within sea turtle hearing range, such as countermeasures used during anti-submarine warfare, would typically be used in off-shore areas and some inshore areas, but not in nearshore areas where detection of beaches or concentrated vessel traffic is relevant for the masking of biologically relevant sounds to reptiles.

Considering the above factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences to sea turtle individuals or populations would not be expected.

The use of sonar and other transducers during training activities would not overlap with green, hawksbill, or leatherback turtle critical habitat around Culebra, Puerto Rico; Mona Island, Puerto Rico; and St. Croix Island, U.S. Virgin Islands respectively. For loggerhead turtle designated critical habitat (79 *Federal Register* 39855), the use of sonar and other transducers have a pathway to impact the physical and biological features of the constricted migratory habitat in the mid-Atlantic and southeast regions by producing "noise pollution" from military activity. However, impacts, if any, on this habitat would be considered insignificant, with no discernible impact on the conservation function of the physical and biological features, and would not prevent a turtle from migrating as these activities are not continuous and most sources are outside of sea turtle hearing range. The physical and biological features identified for the nearshore reproductive, wintering, breeding, and *Sargassum* habitats (National Marine Fisheries Service, 2014b) would not be impacted by the use of sonar and other transducers during training activities.

It is reasonable to assume that crocodilians and terrapins use their hearing similarly to sea turtles and that the types of impacts would be similar to those described above for sea turtles. Within their respective geographic ranges, alligators and terrapins could potentially be exposed to sonar and other transducers in the inshore regions of the Study Area during training activities, as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). Sonar use is not proposed in the nearshore and inshore areas of south Florida known to be inhabited by the ESA-listed American crocodile or in designated American crocodile critical habitat in the Florida Bay, which encompasses creeks, canals, and swamps.

Pursuant to the ESA, the use of sonar and other transducers during training activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, loggerhead, and leatherback turtles; and would have no effect on the ESA-listed American crocodile. There would be no effect on green, hawksbill, or leatherback turtle critical habitat or American crocodile critical habitat. The use of sonar and other transducers during training activities may affect loggerhead constricted migratory habitats in the mid-Atlantic and southeast regions. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA.

Impacts from Sonar and Other Transducers under Alternative 1 for Testing Activities

General categories and characteristics of sonar systems and the number of hours these sonars would be operated during testing under Alternative 1 are described in Section 3.0.3.3.1 (Acoustic Stressors). Activities using sonars and other transducers would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions).

Under Alternative 1, the number of testing activities would fluctuate annually. Testing activities using sonar and other transducers could occur throughout the Study Area, although use would generally occur within Navy range complexes, on Navy testing ranges, or around inshore locations identified in Chapter 2 (Description of Proposed Action and Alternatives). In particular, low-frequency sources during testing activities occur in some coastal waters such as Bath, Maine, Groton, Connecticut; Newport, Rhode Island; the Naval Undersea Warfare Center Division, Newport Testing Range; Narragansett, Rhode Island; Norfolk, Virginia; Kings Bay, Georgia; Mayport, Florida; Port Canaveral, Florida; offshore of Fort Pierce, Florida; South Florida Ocean Measurement Facility; Naval Surface Warfare Center, Panama City Division Testing Range; Pascagoula, Mississippi; as well as in any of the range complexes throughout the Study Area. Low-frequency sources are operated more frequently under testing activities than during training activities. Therefore, although the general impacts from sonar and other transducers under testing would be similar in severity to those described during training, there may be slightly more impacts under testing activities.

The quantitative analysis, using the number of hours of sonar and other transducers for a maximum year of testing activities, predicts that no green or hawksbill sea turtles are likely to be exposed to the high received levels of sound from sonars or other transducers that could cause TTS or PTS under Alternative 1. The quantitative analysis also predicts that a small number of Kemp's ridley, leatherback, and loggerhead turtles may be exposed to levels of sound from sonars or other transducers that could cause TTS. The locations and types of testing activities that would most likely contribute to these impacts are shown in Figure 3.8-13, Figure 3.8-14, and Figure 3.8-15 for Kemp's ridley, leatherback, and loggerhead turtles, respectively. Most impacts are predicted to occur in the Northeast Range Complexes, with fewer impacts in the Jacksonville Range Complex. Fractional estimated impacts per region and activity area represent the probability that the number of estimated impacts by effect will occur in a certain region or be due to a certain activity category.

Notes: Region and Activity bar charts show categories +/- 0.5 percent of the estimated impacts. No impacts during training are estimated for this species. No PTS is estimated for this species. No impacts are estimated from training. ASW: Anti-Submarine Warfare; RC: Range Complex.

Figure 3.8-13: Kemp's Ridley Turtle Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing under Alternative 1

Notes: Region and Activity bar charts show categories +/- 0.5 percent of the estimated impacts. No impacts during training are estimated for this species. No PTS is estimated for this species. No impacts are estimated from training. ASW: Anti-Submarine Warfare; RC: Range Complex.

Figure 3.8-14: Leatherback Sea Turtle Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing under Alternative 1

Notes: Region and Activity bar charts show categories +/- 0.5 percent of the estimated impacts. No impacts during training are estimated for this species. No PTS is estimated for this species. No impacts are estimated from training. ASW: Anti-Submarine Warfare; RC: Range Complex.

Figure 3.8-15: Loggerhead Sea Turtle Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing under Alternative 1

Only a limited number of sonars and other transducers with frequencies within the range of reptile hearing (<2 kHz) and high source levels have the potential to cause TTS and PTS. Any impact to hearing could reduce the distance over which a reptile detects environmental cues, such as the sound of waves or the presence of a vessel or predator. Implementation of mitigation may further reduce the already low risk of auditory impacts on sea turtles. Depending on the sonar source, mitigation includes powering down the sonar or ceasing active sonar transmission if a sea turtle is observed in the mitigation zone, and conducting pierside sonar testing during daylight hours at Port Canaveral, Florida and Kings Bay, Georgia, as discussed in Section 5.3.2 (Acoustic Stressors).

The *ANSI Sound Exposure Guidelines* estimate the risk of a sea turtle responding to a low-frequency sonar (less than 1 kHz) is low regardless of proximity to the source, and there is no risk of a sea turtle responding to a mid-frequency sonar (1–10 kHz) (Popper et al., 2014). A reptile could respond to sounds detected within their limited hearing range if they are close enough to the source. The few studies of sea turtle reactions to sounds, discussed in Section 3.8.3.1.1.5 (Behavioral Reactions), suggest that a behavioral response could consist of temporary avoidance, increased swim speed, or changes in depth, or that there may be no observable response. There is no evidence to suggest that any behavioral response would persist after a sound exposure. It is assumed that a stress response could accompany any behavioral responses or TTS.

Although masking of biologically relevant sounds by the limited number of sonars and other transducers operated in reptile hearing range is possible, this may only occur in certain circumstances. Reptiles most likely use sound to detect nearby broadband, continuous environmental sounds, such as the sounds of waves crashing on the beach. The use characteristics of most sonars, including limited band width, beam directionality, limited beam width, relatively low source levels, low duty cycle, and limited duration of use, would both greatly limit the potential for a sea turtle to detect these sources and limit the potential for masking of broadband, continuous environmental sounds.

Considering the above factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences to sea turtle individuals or populations would not be expected.

The use of sonar and other transducers during training activities would not overlap with green, hawksbill, or leatherback turtle critical habitat around Culebra, Puerto Rico; Mona Island, Puerto Rico; and St. Croix Island, U.S. Virgin Islands respectively. For loggerhead turtle designated critical habitat, the use of sonar and other transducers have a pathway to impact the physical and biological features of the constricted migratory habitat in the mid-Atlantic and southeast regions by producing "noise pollution" from military activity (79 *Federal Register* 39855). However, impacts, if any, on this habitat would be considered insignificant, with no discernible impact on the conservation function of the physical and biological features, and would not prevent a turtle from migrating as these activities are not continuous and most sources are outside of sea turtle hearing range. The physical and biological features identified for the nearshore reproductive, wintering, breeding, and *Sargassum* habitats (National Marine Fisheries Service, 2014b) would not be impacted by the use of sonar and other transducers during testing activities.

It is reasonable to assume that crocodilians and terrapins use their hearing similarly to sea turtles and that the types of impacts would be similar to those described above for sea turtles. Within their respective geographic ranges, alligators and terrapins could potentially be exposed to sonar and other transducers in the inshore regions of the Study Area during testing activities, as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). No sonar use is proposed in the inshore or nearshore areas of south Florida known to be inhabited by the ESA-listed American crocodile, including designated American crocodile critical habitat in the Florida Bay, which encompasses creeks, canals, and swamps.

Pursuant to the ESA, the use of sonar and other transducers during testing activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead turtles; and would have no effect on the ESA-listed American crocodile. There would be no effect on green, hawksbill, or leatherback turtle critical habitat or American crocodile critical habitat since the use of sonar and other transducers during testing activities. The use of sonar and other transducers during testing activities may affect loggerhead constricted migratory habitats in the mid-Atlantic and southeast regions. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA.

3.8.3.1.2.4 Impacts from Sonar and Other Active Sources under Alternative 2

Impacts from Sonar and Other Transducers under Alternative 2 for Training Activities

General categories and characteristics of sonar systems and the number of hours these sonars would be operated during training under Alternative 2 are described in Section 3.0.3.3.1 (Acoustic Stressors). Activities using sonars and other transducers would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions).

Under Alternative 2, the maximum number of major training exercises could occur every year, an additional major training exercise would be conducted in the Gulf of Mexico Range Complex annually, and only the number of civilian port defense activities would fluctuate annually. In addition, all unit level anti-submarine warfare tracking exercise – ship activities would be completed through individual events conducted at sea, rather than through leveraging other anti-submarine warfare training exercises or synthetically. This would result in an increase of sonar use compared to Alternative 1, including sources within reptile hearing range. Training activities using sonar and other transducers could occur throughout the Study Area, although use would generally occur within Navy range complexes, on Navy testing ranges, or around inshore locations identified in Chapter 2 (Description of Proposed Action and Alternatives). Use of sonars associated with anti-submarine warfare would be greatest in the Jacksonville and Virginia Capes Range Complexes. The limited number of sources within sea turtle hearing range would also typically be used in the areas described above.

The quantitative analysis predicts that no sea turtles of any species are likely to be exposed to the high received levels of sound from sonars or other transducers that could cause TTS or PTS during a maximum year of training activities under Alternative 2. Although there would be an increase in sonar use compared to Alternative 1, the potential for and type of impacts on reptiles would be the similar. This is because reptiles are capable of detecting only a limited number of sonars due to their limited hearing range.

The *ANSI Sound Exposure Guidelines* estimate the risk of a sea turtle responding to a low-frequency sonar (less than 1 kHz) is low regardless of proximity to the source, and there is no risk of a sea turtle responding to a mid-frequency sonar (1 to 10 kHz) (Popper et al., 2014). A reptile could respond to sounds detected within their limited hearing range if they are close enough to the source. The few studies of sea turtle reactions to sounds, discussed in Section 3.8.3.1.1.5 (Behavioral Reactions), suggest that a behavioral response could consist of temporary avoidance, increased swim speed, or changes in depth, or that there may be no observable response. Use of sonar and other transducers would typically be transient and temporary, and there is no evidence to suggest that any behavioral response would persist after a sound exposure. It is assumed that a stress response could accompany any behavioral responses.

Implementation of mitigation may further reduce the already low risk of auditory impacts on sea turtles. Depending on the sonar source, mitigation includes powering down the sonar or ceasing active sonar transmission if a sea turtle is observed in the mitigation zone, as discussed in Section 5.3.2 (Acoustic Stressors).

Although masking of biologically relevant sounds by the limited number of sonars and other transducers operated in reptile hearing range is possible, this may only occur in certain circumstances. Reptiles most likely use sound to detect nearby broadband, continuous environmental sounds, such as the sounds of waves crashing on the beach. The use characteristics of most low-frequency sonars, including limited band width, beam directionality, limited beam width, relatively low source levels, low duty cycle, and limited duration of use, would both greatly limit the potential for a reptile to detect these sources and limit the potential for masking of broadband, continuous environmental sounds.

Considering the above factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences to sea turtle individuals or populations would not be expected.

The use of sonar and other transducers during training activities would not overlap with green, hawksbill, or leatherback turtle critical habitat around Culebra, Puerto Rico; Mona Island, Puerto Rico; and St. Croix Island, U.S. Virgin Islands respectively. For loggerhead turtle designated critical habitat, the use of sonar and other transducers have a pathway to impact the physical and biological features of the constricted migratory habitat in the mid-Atlantic and southeast regions by producing "noise pollution" from military activity (79 *Federal Register* 39855). However, impacts, if any, on this habitat would be considered insignificant, with no discernible impact on the conservation function of the physical and biological features, and would not prevent a turtle from migrating as these activities are not continuous and most sources are outside of sea turtle hearing range. The physical and biological features of the nearshore reproductive, wintering, breeding, and *Sargassum* habitats (National Marine Fisheries Service, 2014b) would not be impacted by the use of sonar and other transducers during training activities.

It is reasonable to assume that crocodilians and terrapins use their hearing similarly to sea turtles and that the types of impacts would be similar to those described above for sea turtles. Within their respective geographic ranges, alligators and terrapins could potentially be exposed to sonar and other transducers in the inshore regions of the Study Area during testing activities, as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). No sonar use is proposed in the inshore or nearshore areas of south Florida known to be inhabited by the ESA-listed American crocodile, including designated American crocodile critical habitat in the Florida Bay, which encompasses creeks, canals, and swamps.

Pursuant to the ESA, the use of sonar and other transducers during training activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, loggerhead, and leatherback sea turtles; and would have no effect on the ESA-listed American crocodile. There would be no effect on green, hawksbill, or leatherback turtle or American crocodile critical habitat. The use of sonar and other transducers during training activities may affect loggerhead constricted migratory habitats in the mid-Atlantic and southeast regions.

Impacts from Sonar and Other Transducers under Alternative 2 for Testing Activities

General categories and characteristics of sonar systems and the number of hours these sonars would be operated during testing under Alternative 2 are described in Section 3.0.3.3.1 (Acoustic Stressors). Activities using sonars and other transducers would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions).

Under Alternative 2, the maximum number of nearly all testing activities would occur every year. This would result in an increase of sonar use compared to Alternative 1, including sources within reptile hearing range. Testing activities using sonar and other transducers could occur throughout the Study Area, although use would generally occur within Navy range complexes, on Navy testing ranges, or around inshore locations identified in Chapter 2 (Description of Proposed Action and Alternatives).

The quantitative analysis predicts that no green or hawksbill sea turtles are likely to be exposed to the high received levels of sound from sonars or other transducers that could cause PTS or TTS during testing activities under Alternative 2. The quantitative analysis also predicts that a small number of Kemp's ridley, loggerhead, and leatherback turtles may be exposed to levels of sound from sonars or other transducers that could cause TTS during testing activities under Alternative 2. The locations and types of testing activities that would most likely contribute to these impacts are shown in Figure 3.8-16, Figure 3.8-17, and Figure 3.8-18 for Kemp's ridley, leatherback, and loggerhead turtles, respectively. Most impacts are predicted to occur in the Northeast Range Complexes. Fractional estimated impacts per region and activity area represent the probability that the number of estimated impacts by effect will occur in a certain region or be due to a certain activity category.

Notes: Region and Activity bar charts show categories +/- 0.5 percent of the estimated impacts. No impacts during training are estimated for this species. No PTS is estimated for this species. No impacts are estimated from training. ASW: Anti-Submarine Warfare; RC: Range Complex.

Figure 3.8-16: Kemp's Ridley Turtle Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing under Alternative 2

Notes: Region and Activity bar charts show categories +/- 0.5 percent of the estimated impacts. No impacts during training are estimated for this species. No PTS is estimated for this species. No impacts are estimated from training. ASW: Anti-Submarine Warfare; RC: Range Complex.

Figure 3.8-17: Leatherback Sea Turtle Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing under Alternative 2

Notes: Region and Activity bar charts show categories +/- 0.5 percent of the estimated impacts. No impacts during training are estimated for this species. No PTS is estimated for this species. No impacts are estimated from training. ASW: Anti-Submarine Warfare; RC: Range Complex.

Figure 3.8-18: Loggerhead Sea Turtle Impacts Estimated per Year from Sonar and Other Transducers Used During Training and Testing under Alternative 2

Only a limited number of sonars and other transducers with frequencies within the range of reptile hearing (<2 kHz) and high source levels have the potential to cause TTS and PTS. Any impact to hearing could reduce the distance over which a reptile detects environmental cues, such as the sound of waves or the presence of a vessel or predator. Implementation of mitigation may further reduce the already low risk of auditory impacts on sea turtles. Depending on the sonar source, mitigation includes powering down the sonar or ceasing active sonar transmission if a sea turtle is observed in the mitigation zone, and conducting pierside sonar testing during daylight hours at Port Canaveral, Florida and Kings Bay, Georgia, as discussed in Section 5.3.2 (Acoustic Stressors).

The *ANSI Sound Exposure Guidelines* estimate the risk of a sea turtle responding to a low-frequency sonar (less than 1 kHz) is low regardless of proximity to the source, and there is no risk of a sea turtle responding to a mid-frequency sonar (1–10 kHz) (Popper et al., 2014). A reptile could respond to sounds detected within their limited hearing range if they are close enough to the source. The few studies of sea turtle reactions to sounds, discussed in Section 3.8.3.1.1.5 (Behavioral Reactions), suggest that a behavioral response could consist of temporary avoidance, increased swim speed, or changes in depth, or that there may be no observable response. There is no evidence to suggest that any behavioral response would persist after the sound exposure ends. It is assumed that a stress response could accompany any behavioral responses or TTS.

Although masking of biologically relevant sounds by the limited number of sonars and other transducers operated in reptile hearing range is possible, this may only occur in certain circumstances. Reptiles most likely use sound to detect nearby broadband, continuous environmental sounds, such as the sounds of waves crashing on the beach. The use characteristics of most sonars, including limited band width, beam directionality, limited beam width, relatively low source levels, low duty cycle, and limited duration of use, would both greatly limit the potential for a sea turtle to detect these sources and limit the potential for masking of broadband, continuous environmental sounds.

Considering the above factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences to sea turtle individuals or populations would not be expected.

The use of sonar and other transducers during testing activities would not overlap with green, hawksbill, or leatherback turtle critical habitat around Culebra, Puerto Rico; Mona Island, Puerto Rico; and St. Croix Island, U.S. Virgin Islands, respectively. For loggerhead turtle-designated critical habitat (79 *Federal Register* 39855), the use of sonar and other transducers have a pathway to impact the physical and biological features of the constricted migratory habitat in the mid-Atlantic and southeast regions by producing "noise pollution" from military activity. However, impacts, if any, on this habitat would be considered insignificant, with no discernible impact on the conservation function of the physical and biological features, and would not prevent a turtle from migrating as these activities are not continuous and most sources are outside of sea turtle hearing range. The physical and biological features of the nearshore reproductive, wintering, breeding, and *Sargassum* habitats (National Marine Fisheries Service, 2014b) would not be impacted by the use of sonar and other transducers during testing activities.

It is reasonable to assume that crocodilians and terrapins use their hearing similarly to sea turtles and that the types of impacts would be similar to those described above for sea turtles. Within their respective geographic ranges, alligators and terrapins could potentially be exposed to sonar and other transducers in the inshore regions of the Study Area during testing activities, as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). No sonar use is proposed in the inshore or nearshore areas of south Florida known to be inhabited by the ESA-listed American crocodile, including designated American crocodile critical habitat in the Florida Bay, which encompasses creeks, canals, and swamps.

Pursuant to the ESA, the use of sonar and other transducers during testing activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead turtles; and would have no effect on the ESA-listed American crocodile. There would be no effect on green, hawksbill, or leatherback turtle critical habitat or American crocodile habitat. The use of sonar and other transducers during testing activities may affect loggerhead constricted migratory habitats in the mid-Atlantic and southeast regions.

3.8.3.1.2.5 Impacts from Sonar and Other Transducers under the No Action Alternative

Under the No-Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various acoustic stressors (e.g., sonar and other transducers) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.8.3.1.3 Impacts from Air Guns

Air guns use bursts of pressurized air to create broadband, impulsive sounds. Any use of air guns would typically be transient and temporary. Section 3.0.3.3.1.2 (Air Guns) provides additional details on the use and acoustic characteristics of the small air guns used in these activities. Because no use of air guns is proposed in known crocodilian habitat, the remainder of the analysis of impacts from air guns focuses on sea turtles and terrapins.

3.8.3.1.3.1 Methods for Analyzing Impacts from Air Guns

Potential impacts considered are hearing loss due to threshold shift (permanent or temporary), masking of other biologically relevant sounds, physiological stress, and changes in behavior. The Navy's quantitative analysis to determine impacts to sea turtles and marine mammals uses the Navy Acoustic Effects Model to produce initial estimates of the number of animals that may experience these effects; these estimates are further refined by considering animal avoidance of sound-producing activities and implementation of mitigation. The steps of this quantitative analysis are described in Section 3.0.1.2 (Navy's Quantitative Analysis to Determine Impacts to Sea Turtles and Marine Mammals), which takes into account:

- criteria and thresholds used to predict impacts from air guns (see below);
- the density and spatial distribution of sea turtle; and
- the influence of environmental parameters (e.g., temperature, depth, salinity) on sound propagation when estimating the received sound level on the animals

A further detailed explanation of this analysis is provided in the technical report titled *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing (U.S. Department of the Navy, 2018).*Since terrapins have similar hearing range and sensitivity as sea turtles, as described in Section 3.8.2.1.4 (Hearing and Vocalization), it is inferred that terrapins could react similarly to air guns as sea turtles.

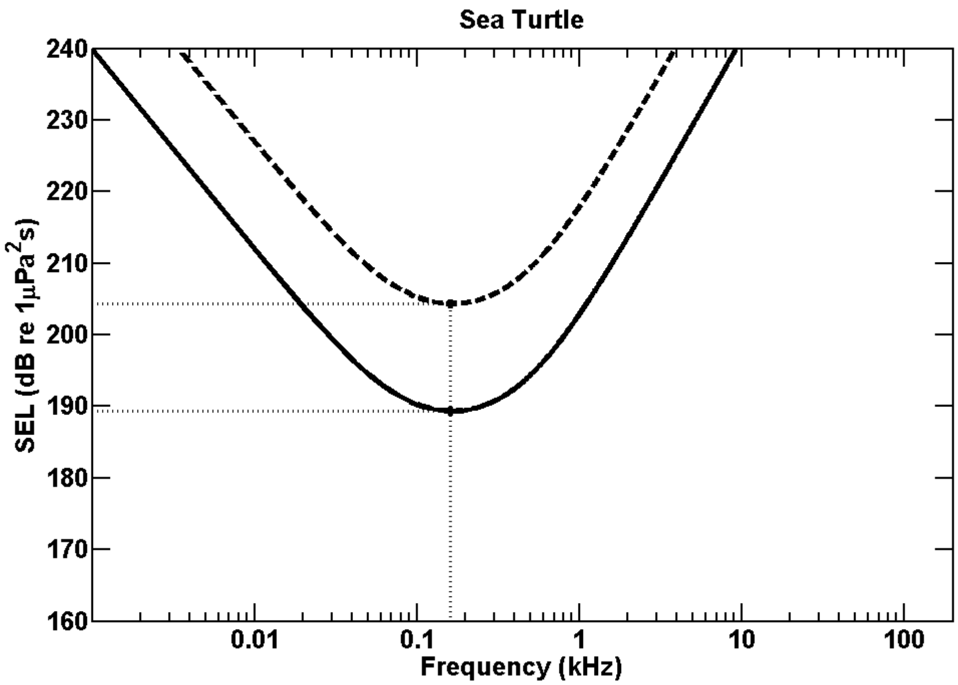
Criteria and Thresholds used to Predict Impacts on Sea Turtles from Air Guns

Auditory Weighting Functions

Animals are not equally sensitive to noise at all frequencies. To capture the frequency-dependent nature of the effects of noise, auditory weighting functions are used. The auditory weighting function for sea turtles presented above in Section 3.8.3.1.2.1 (Methods for Analyzing Impacts from Sonar and Other Transducers) is also used in the quantitative assessment of auditory impacts due to air guns.

Hearing Loss from Air Guns

No studies of hearing loss have been conducted on sea turtles. Therefore, sea turtle susceptibility to hearing loss due to an air gun exposure is evaluated using knowledge about sea turtle hearing abilities in combination with auditory effect data from other species (marine mammals and fish). This yields sea turtle exposure functions, shown in Figure 3.8-19, which are mathematical functions that relate the SELs for onset of PTS or TTS to the frequency of the underwater impulsive sound exposure. The derivation of the sea turtle impulsive exposure functions are provided in the technical report *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (U.S. Department of the Navy, 2017).



Notes: kHz: kilohertz; SEL: Sound Exposure Level, dB re 1 μPa²s: decibels referenced to 1 micropascal squared second. The solid black curve is the exposure function for TTS onset and the dashed black curve is the exposure function for PTS onset. Small dashed lines and asterisks indicate the SEL thresholds and most-sensitive frequency for TTS and PTS.

Figure 3.8-19: TTS and PTS Exposure Functions for Impulsive Sounds

For impulsive sounds, hearing loss in other species has also been observed to be related to the unweighted peak pressure of a received sound. Because this data does not exist for sea turtles, unweighted peak pressure thresholds for PTS and TTS were developed by applying relationships observed between impulsive peak pressure TTS thresholds and auditory sensitivity in marine mammals to sea turtles. This results in dual-metric hearing loss criteria for sea turtles for impulsive sound exposure: the SEL-based exposure functions in Figure 3.8-18 and the peak pressure thresholds in Table 3.8-2. The derivation of the sea turtle impulsive peak pressure PTS and TTS thresholds are provided in the technical report *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (U.S. Department of the Navy, 2017).

Table 3.8-2: PTS and TTS Peak Pressure Thresholds for Sea Turtles Exposed to Impulsive Sounds

Auditory Effect	*Unweighted Peak Pressure Threshold*
TTS	226 dB re 1 μPa SPL peak
PTS	232 dB re 1 μPa SPL peak

Notes: dB re I μPa = decibels referenced to 1 micropascal,
PTS: permanent threshold shift, TTS: temporary threshold shift,
SPL: sound pressure level

3.8.3.1.3.2 Impact Ranges for Air Guns

Ranges to the onset of PTS or TTS for the air guns used in Navy activities are shown in Table 3.8-3. The majority of air gun activities occur offshore and involve the use of a single shot or 10 shots. Fewer activities are conducted pierside and could use up to a maximum of 100 shots. The following ranges are based on the SEL metrics for PTS and TTS for 100 firing of an air gun, a conservative estimate of the number of air gun firings that could occur over a single exposure duration at a single location. Ranges based on the peak pressure metrics for PTS and TTS for firings of an air gun, regardless of number of firings, are zero meters.

Table 3.8-3: Ranges to Permanent Threshold Shift and Temporary Threshold Shift for Sea Turtles Exposed to 100 Air Gun Firings

Range (m)	
PTS	***TTS***
13	100

3.8.3.1.3.3 Impacts from Air Guns under Alternative 1

Impacts from Air Guns under Alternative 1 for Training Activities

Training activities under Alternative 1 do not include the use of air guns.

Impacts from Air Guns under Alternative 1 for Testing Activities

Characteristics of air guns and the number of times they would be operated during testing under Alternative 1 are described in Section 3.0.3.3.1 (Acoustic Stressors). Activities using air guns would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). Under Alternative 1, small air guns (12–60 cubic inches) would be fired pierside at the Naval Undersea Warfare Center Division, Newport Testing Range, and at off-shore locations typically in the Northeast, Virginia Capes, and Gulf of Mexico Range Complexes.

These small air guns lack large pressures that could cause non-auditory injuries. The broadband impulsive sounds produced by these small air guns could only cause PTS and TTS for sea turtles within a short distance. Considering that an air gun would be shut down if a sea turtle was sighted in the mitigation zone as described in Chapter 5 (Mitigation), any TTS is highly unlikely. The quantitative analysis, for a maximum year of air gun testing activities, predicts that no sea turtles of any species are likely to be exposed to the received levels of sound from air guns during testing activities, in their hearing range, that could cause TTS or PTS.

The working group that prepared the *ANSI Sound Exposure Guidelines* (Popper et al., 2014) provide parametric descriptors of sea turtle behavioral responses to air guns. Popper et al. (2014) estimate the risk of sea turtles responding to air guns is high, moderate, and low while at near (tens of meters), intermediate (hundreds of meters), and far (thousands of meters) distances from the source, respectively. Based on the few studies of sea turtle reactions to air guns, any behavioral reactions to air gun firings may be to increase swim speed or avoid the air gun. McCauley et al. (2000) estimated that sea turtles would begin to exhibit avoidance behavior when the received level of air gun firings was around 175 dB re 1 µPa, based on several studies of sea turtle exposures to air guns. The few studies of sea turtle reactions to sounds suggest that a behavioral response could consist of temporary avoidance, increased swim speed, or changes in depth, or that there may be no observable response. There is no evidence to suggest that any behavioral response would persist after a sound exposure. It is assumed that a stress response could accompany any behavioral responses.

Sea turtles most likely use sound to detect nearby broadband, continuous environmental sounds, such as the sounds of waves crashing on the beach. Due to the low duration of an individual air gun shot, approximately 0.1 second, and the low duty cycle of sequential shots, the potential for masking from these small air guns would be low. Additionally, the pierside air gun use would only occur several times a year and would use a limited number of air gun shots, limiting any masking, while the use of small air guns in off-shore waters would not interfere with detection of sounds in shore environments.

Considering the above factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences to sea turtle individuals or populations would not be expected.

The use of air guns during testing activities would not overlap with green, hawksbill, or leatherback turtle critical habitat around Culebra, Puerto Rico; Mona Island, Puerto Rico; and St. Croix Island, U.S. Virgin Islands, respectively. Loggerhead turtle habitat would not be impacted by air gun use during testing activities.

It is reasonable to assume that terrapins use their hearing similarly to sea turtles and that the types of impacts on these species would be similar to impacts on sea turtles. Air guns within reptile hearing range are not likely to be used in nearshore locations where crocodilians could be present, however terrapins may be present in Newport, Rhode Island where pierside air gun activities occur. Due to the similarity in hearing between terrapins and sea turtles, the low frequency of air gun use, and the low duration of shots, impacts, if any, are assumed to parallel those described above for sea turtles. No air gun use is proposed in the areas known to be inhabited by alligators or the ESA-listed American crocodile, including designated American crocodile critical habitat in Florida Bay, which encompasses creeks, canals, and swamps.

Pursuant to the ESA, the use of air guns during testing activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead turtles; would have no effect on the ESA-listed American crocodile. The use of air guns would have no effect on green, hawksbill, leatherback, or loggerhead turtle critical habitat or on American crocodile critical habitat. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA.

3.8.3.1.3.4 Impacts from Air Guns under Alternative 2

Impacts from Air Guns under Alternative 2 for Training Activities

Training activities under Alternative 2 do not include the use of air guns.

Impacts from Air Guns under Alternative 2 for Testing Activities

The number and locations of air gun testing activities planned under Alternative 2 are identical to those planned under Alternative 1; therefore, the estimated impacts would be identical. Considering the factors described under Alternative 1 and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences to sea turtle individuals or populations would not be expected. It is reasonable to assume that terrapins use their hearing similarly to sea turtles and that the types of impacts on these species would be similar to impacts on sea turtles. Air guns within reptile hearing range are not likely to be used in nearshore locations where crocodilians could be present, however terrapins may be present in Newport, Rhode Island where pierside air gun activities occur. Due to the similarity in hearing between terrapins and sea turtles, the low frequency of air gun use, and the low duration of shots, impacts, if any, are assumed to parallel those described above for sea turtles. No air gun use is proposed in the areas known to be inhabited by alligators or the ESA-listed American crocodile, including designated American crocodile critical habitat in Florida Bay, which encompasses creeks, canals, and swamps.

Pursuant to the ESA, the use of air guns during testing activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead turtles; would have no effect on the ESA-listed American crocodile; and would have no effect on green, hawksbill, loggerhead, or leatherback turtle critical habitat or on American crocodile critical habitat.

3.8.3.1.3.5 Impacts from Air Guns under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various acoustic stressors (e.g., air guns) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.8.3.1.4 Impacts from Pile Driving

Sea turtles could be exposed to sounds from impact pile driving and vibratory pile extraction during the construction and removal phases of the Elevated Causeway System. This training activity involves the use of an impact hammer to drive 24 in. steel piles into the sediment to support an elevated causeway to the shore and a vibratory hammer to later remove the piles that support the causeway structure. Section 3.0.3.3.1.3 (Pile Driving) provides additional details on pile driving activities and the noise levels measured from a prior elevated causeway installation and removal.

Because no pile driving or vibratory extraction is proposed in known crocodilian or terrapin habitat, the remainder of the analysis of impacts from pile driving focuses on sea turtles.

3.8.3.1.4.1 Methods for Analyzing Impacts from Pile Driving

Potential impacts considered are hearing loss due to threshold shift (permanent or temporary), masking of other biologically relevant sounds, physiological stress, and changes in behavior.

The Navy's quantitative analysis to determine impacts on sea turtles and marine mammals for pile driving produces initial estimates of the number of animals that may experience these effects; these estimates are further refined by considering animal avoidance of sound-producing activities and implementation of mitigation. The steps of this quantitative analysis are described in Section 3.0.1.2 (Navy's Quantitative Analysis to Determine Impacts to Sea Turtles and Marine Mammals), which takes into account:

- criteria and thresholds used to predict impacts from pile driving (see below); and
- the density and spatial distribution of sea turtles.

A further detailed explanation of this analysis is provided in the technical report *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2018).

<u>**Criteria and Thresholds used to Predict Impacts on Sea Turtles from Pile Driving**</u>

Auditory Weighting Functions

Animals are not equally sensitive to noise at all frequencies. To capture the frequency-dependent nature of the effects of noise, auditory weighting functions are used. The auditory weighting function for sea turtles presented above in Section 3.8.3.1.2.1 (Methods for Analyzing Impacts from Sonar and Other Transducers) is also used in the quantitative assessment of auditory impacts due to pile driving.

Hearing Loss from Pile Driving

Because impact pile driving produces impulsive noise, the criteria used to assess the onset of TTS and PTS are identical to those used for air guns, as described in Section 3.8.3.1.3.1 (Methods for Analyzing Impacts from Air Guns).

Because vibratory pile extraction produces continuous, non-impulsive noise, the criteria used to assess the onset of TTS and PTS due to exposure to sonars are used to assess auditory impacts on sea turtles, as described in Section 3.8.3.1.2.1 (Methods for Analyzing Impacts from Sonar and Other Transducers).

Modeling of Pile Driving Noise

Underwater noise effects from pile driving and vibratory pile extraction were modeled using actual measures of impact pile driving and vibratory removal during construction of an elevated causeway (Illingworth and Rodkin, 2015, 2017). A conservative estimate of spreading loss of sound in shallow coastal waters (i.e., transmission loss = $16.5*Log_{10}$ [radius]) was applied based on spreading loss observed in actual measurements. Inputs used in the model are provided in Section 3.0.3.3.1.3 (Pile Driving), including source levels, the number of strikes required to drive a pile and the duration of vibratory removal for a pile, the number of piles driven or removed per day, and the number of days of pile driving and removal.

3.8.3.1.4.2 Impact Ranges for Pile Driving

The ranges to the onset of TTS and PTS for sea turtles exposed to impact pile driving are shown in Table 3.8-4. The ranges to effect are short due to sea turtles' relatively high thresholds for any auditory impacts compared to the source levels of the impact pile driving conducted during Navy training.

Table 3.8-4: Ranges to PTS and TTS Sea Turtles Exposed to Impact Pile Driving

Type of Activity	*PTS (m)*	*TTS (m)*
Impact Pile Driving (single pile)	2	19

Notes: PTS: permanent threshold shift, TTS: temporary threshold shift. Calculations for ranges to TTS and PTS assume a sound exposure level accumulated over a duration of one minute, after which time an animal is assumed to avoid the immediate area.

Because vibratory pile extraction has a low source level, it is not possible for a sea turtle to experience PTS or TTS, even if exposed to a full day of pile removal.

3.8.3.1.4.3 Impacts from Pile Driving under Alternative 1

<u>**Impacts from Pile Driving under Alternative 1 for Training Activities**</u>

Characteristics of pile driving (impact and vibratory extraction) and the number of times pile driving for the elevated causeway system would occur during training under Alternative 1 are described in Section 3.0.3.3.1 (Acoustic Stressors). Activities with pile driving would be conducted as described in Chapter 2

(Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). This activity would take place nearshore and within the surf zone, up to two times per year, once at Joint Expeditionary Base Little Creek/Fort Story, Virginia, and once at Marine Corps Base Camp Lejeune, North Carolina.

Impulses from the impact hammer strikes are broadband, within the hearing range of sea turtles, and carry most of their energy in the lower frequencies. The quantitative analysis, for a maximum duration of pile driving activities during training activities, predicts that no sea turtles of any species are likely to be exposed to the received levels of sound, in their hearing range, that could cause TTS or PTS.

The impulse from impact pile driving can also travel through the bottom sediment, potentially disturbing sea turtles that may be present near the bottom. Any impacts on sea turtles may be reduced by soft starts. As discussed in Section 2.3.3.14 (Pile Driving Safety), as a standard operating procedure, the Navy performs soft starts at reduced energy during an initial set of strikes from an impact hammer. Soft starts may "warn" sea turtles and cause them to move away from the sound source before impact pile driving increases to full operating capacity. Soft starts were not considered when calculating the number of sea turtles that could be impacted, nor was the possibility that a sea turtle would avoid the construction area.

Sound produced from a vibratory hammer is broadband, continuous noise that is produced at a much lower level than impact driving. The quantitative analysis estimates that no sea turtles could be exposed to levels of vibratory pile extraction that could cause TTS or PTS. To further avoid the potential for impacts, the Navy will implement mitigation for pile driving that includes ceasing impact pile driving or vibratory pile extraction if a sea turtle is observed in the mitigation zone, as discussed in Section 5.3.2 (Acoustic Stressors).

The working group that prepared the *ANSI Sound Exposure Guidelines* (Popper et al., 2014) provide parametric descriptors of sea turtle behavioral responses to impact pile driving. Popper et al. (2014) estimate the risk of sea turtles responding to impact pile driving is high, moderate, and low while at near (tens of meters), intermediate (hundreds of meters), and far (thousands of meters) distances from the source respectively. Based on prior observations of sea turtle reactions to sound, if a behavioral reaction were to occur, the responses could include increases in swim speed, change of position in the water column, or avoidance of the sound. There is no evidence to suggest that any behavioral response would persist beyond the sound exposure. It is assumed that a stress response could accompany any behavioral response or TTS.

Sea turtles most likely use sound to detect nearby broadband, continuous environmental sounds, such as the sounds of waves crashing on the beach. Despite the short duration of each impulse from an impact pile driving strike, the rate of impulses has the potential to result in some auditory masking of shore sounds or broadband vessel noise for sea turtles. Vibratory pile extraction is more likely than impact pile driving to cause masking of continuous broadband environmental sounds; however, due to its low source level, the masking effect would only be relevant in a small area around the vibratory pile extraction activity. These coastal areas tend to have high ambient noise levels due to natural (breaking waves) and anthropogenic sources. For both types of activities, masking would only occur during the brief periods of time during which pile driving or removal is actively occurring, approximately less than two hours per day for two weeks in any year.

Considering the above factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences to sea turtle individuals or populations would not be expected.

Hawksbill turtles are considered extralimital north of Florida, and would not occur near pile driving activities. Additionally, pile driving during training activities would not overlap with green, hawksbill, or leatherback turtle critical habitat around Culebra, Puerto Rico; Mona Island, Puerto Rico; and St. Croix Island, U.S. Virgin Islands respectively. Loggerhead turtle habitat would not be impacted by pile driving use during training activities. No pile driving activities will occur in the areas known to be inhabited by the ESA-listed American crocodile, including designated American crocodile critical habitat in Florida Bay, which encompasses creeks, canals, and swamps.

Pursuant to the ESA, the pile driving and extraction during training under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead turtles; would have no effect on the ESA-listed American crocodile; and would have no effect on green, hawksbill, leatherback, or loggerhead turtle critical habitat or on American crocodile critical habitat. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA.

Impacts from Pile Driving under Alternative 1 for Testing Activities

Testing activities under Alternative 1 do not include the use of pile driving (impact or vibratory).

3.8.3.1.4.4 Impacts from Pile Driving under Alternative 2

Impacts from Pile Driving under Alternative 2 for Training Activities

Pile driving training activities planned under Alternative 2 are identical to those planned under Alternative 1; therefore, the estimated impacts would be identical. Considering the factors described under Alternative 1 and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences to sea turtle individuals or populations would not be expected.

Pursuant to the ESA, the pile driving and removal during training under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, loggerhead, and leatherback sea turtles; would have no effect on the ESA-listed American crocodile; and would have no effect on green, hawksbill, loggerhead, or leatherback sea turtle critical habitat or on American crocodile critical habitat.

Impacts from Pile Driving under Alternative 2 for Testing Activities

Testing activities under Alternative 2 do not include the use of pile driving (impact or vibratory).

3.8.3.1.4.5 Impacts from Pile Driving under the No Action Alternative

Under the No-Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various acoustic stressors (e.g., pile driving) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.8.3.1.5 Impacts from Vessel Noise

The characteristics of noise produced by Navy vessels and their overall contribution to vessel noise in the Study Area are described in Section 3.0.3.3.1.4 (Vessel Noise). Navy vessels make up a very small percentage of the overall traffic, and, because most Navy ships are quieter than similar-sized commercial vessels, naval vessel noise contributes a very small portion of radiated noise in Navy operating areas (Mintz & Filadelfo, 2011; Mintz, 2012). Even during major training exercises, when a higher number of Navy vessels are at sea, the Navy vessel contribution to overall ship radiated noise is very small. Navy ships make up only 20 percent of total ship traffic in the AFTT Study Area (Mintz, 2016). In terms of anthropogenic noise, Navy ships would contribute a correspondingly smaller amount of vessel noise compared to more common commercial shipping and boating (Mintz, 2012; Mintz & Filadelfo, 2011).

3.8.3.1.5.1 Methods for Analyzing Impacts from Vessel Noise

Potential impacts considered are masking of other biologically relevant sounds, physiological stress, and changes in behavior. The source levels of vessels are below the level of sound that would cause hearing loss for sea turtles.

There is little information on assessing behavioral responses of sea turtles to vessels. Sea turtles have been both observed to respond (DeRuiter & Doukara, 2012) and not respond (Weir, 2007) during seismic surveys, although any reaction could have been due to the active firing of air gun arrays, ship noise, ship presence, or some combination thereof. Lacking data that assesses sea turtle reactions solely to vessel noise, the *ANSI Sound Exposure Guidelines* suggest that the relative risk of a sea turtle behaviorally responding to a continuous noise, such as vessel noise, is high when near a source (tens of meters), moderate when at an intermediate distance (hundreds of meters), and low at farther distances. These recommendations did not consider source level. While it is reasonable to assume that sea turtles may exhibit some behavioral response to vessels, numerous sea turtles bear scars that appear to have been caused by propeller cuts or collisions with vessel hulls that may have been exacerbated by a sea turtle surfacing reaction or lack of reaction to vessels (Hazel et al., 2007; Lutcavage et al., 1997).

Since crocodilians and terrapins have similar hearing range and sensitivity as sea turtles, as described in Section 3.8.2.1.4 (Hearing and Vocalization), it is inferred that crocodilians and terrapins would react similarly to vessel noise as sea turtles.

3.8.3.1.5.2 Impacts from Vessel Noise under Alternative 1

Impacts from Vessel Noise under Alternative 1 for Training Activities

Characteristics of Navy vessel noise are described in Section 3.0.3.3.1 (Acoustic Stressors). Activities with vessel noise would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). Vessel movements involve transits to and from ports to various locations within the Study Area, and many ongoing and proposed activities within the Study Area involve maneuvers by various types of surface ships, boats, and submarines (collectively referred to as vessels), as well as unmanned vehicles. Activities involving vessel movements occur intermittently and are variable in duration, ranging from a few hours up to two weeks. A study of Navy vessel traffic found that traffic was heaviest just offshore of Norfolk and Jacksonville, as well as along the coastal waters between the two ports (Mintz & Filadelfo, 2011; Mintz, 2012).

Surface combatant ships (e.g., destroyers, guided missile cruisers, and littoral combat ships) and submarines especially are designed to be quiet to evade enemy detection. Reptiles exposed to these Navy vessels may not respond at all or exhibit brief startle dive reactions, if, for example, basking on the surface near a passing vessel. Even for louder vessels, such as Navy oilers, it is not clear that reptiles would typically exhibit any reaction other than a brief startle and avoidance reaction, if they react at all. Any of these short-term reactions to vessels are not likely to disrupt important behavioral patterns more than for a brief moment. The size and severity of these impacts would be insignificant, and not rise to the level of measurable impacts. Acoustic masking, especially from larger, non-combatant vessels, is possible. Vessels produce continuous broadband noise, with larger vessels producing sound that is dominant in the lower frequencies where reptile hearing is most sensitive, as described in Section 3.0.3.3.1.4 (Vessel Noise) (Mintz & Filadelfo, 2011; Richardson et al., 1995; Urick, 1983). Smaller vessels emit more energy in higher frequencies, much of which would not be detectable by reptiles. Sea turtles and terrapins most likely use sound to detect nearby broadband, continuous low-frequency environmental sounds, such as the sounds of waves crashing on the beach, so vessel noise in those habitats may cause more meaningful masking. However, most vessel use would be in harbors or in transit to offshore areas, limiting masking impacts on sea turtles in many shore areas. Crocodilians use low-frequency sounds for vocalization during various behaviors, and any potential for masking impacts would be limited to inshore environments for short durations during vessel transit. Existing high ambient noise levels in ports and harbors with non-Navy vessel traffic and in shipping lanes with large commercial vessel traffic would limit the potential for masking by naval vessels in those areas. In offshore areas with lower ambient noise, the duration of any masking effects in a particular location would depend on the time in transit by a vessel through an area. Because sea turtles and terrapins appear to rely on senses other than hearing for in-water foraging and navigation, any impact of temporary masking is likely minor or inconsequential. Hazel et al. (2007) noted in one study that green sea turtles did not have time to react to vessels moving at speeds of about 10 knots, but reacted frequently to vessels at speeds of about two knots. Detection, therefore, was suggested to be based on the turtle's ability to see rather than hear an oncoming vessel.

Vessel noise during training activities would not overlap with green, hawksbill, or leatherback turtle critical habitat around Culebra, Puerto Rico; Mona Island, Puerto Rico; and St. Croix Island, U.S. Virgin Islands, respectively. For loggerhead turtle critical habitat (79 *Federal Register* 39855), vessel noise during training activities would have a pathway to impact the physical and biological features of the constricted migratory habitat in the mid-Atlantic and southeast regions by producing "noise pollution" from shipping or military activity. The impacts on this habitat would be considered insignificant with no discernible impact on the conservation function of the physical and biological features as activity would not prevent a turtle from migrating due to the transient nature of vessels. The physical and biological features of the nearshore reproductive, wintering, breeding, and *Sargassum* habitats (National Marine Fisheries Service, 2014b) would not be impacted by vessel noise during training activities.

It is reasonable to assume that crocodilians and terrapins use their hearing similarly to sea turtles and that the types of impacts would be similar to those described above for sea turtles. Within their respective geographic ranges, crocodilians and terrapins could potentially be exposed to vessel noise in the inshore regions of the Study Area during training activities, as described in Appendix A (Navy Activity Descriptions). Navy vessel presence would be unlikely in ESA-listed American crocodile habitat, which consists of shallow nearshore habitat in southern Florida; however, it is possible that American crocodiles could be occasionally exposed to Navy vessel noise, mostly from smaller support vessels. Vessel noise produced during training activities would not impact critical habitat in the Florida Bay, which encompasses creeks, canals, and swamps.

Because impacts on individual sea turtles, crocodilians, or terrapins, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Accordingly, there would be no consequences to any sea turtle, crocodilian, or terrapin populations.

Pursuant to the ESA, vessel noise produced during training activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead turtles and the ESA-listed American crocodile. There would be no effect on green, hawksbill, or leatherback turtle critical habitat or on American crocodile critical habitat. Vessel noise during training activities may affect loggerhead constricted migratory habitats in the mid-Atlantic and southeast. The Navy has consulted with NMFS and USFWS as required by section 7(a)(2) of the ESA.

Impacts from Vessel Noise under Alternative 1 for Testing Activities

Characteristics of Navy vessel noise are described in Section 3.0.3.3.1 (Acoustic Stressors). Activities with vessel noise would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). Testing activities under Alternative 1 include vessel movement during many events. Because many testing activities would use the same or similar vessels as Navy training events, the general locations and types of effects due to vessel noise described above for training would be similar for many testing activities. In addition, smaller vessels would typically be used on Navy testing ranges. Navy vessel noise would continue to be a minor contributor to overall radiated vessel noise in the exclusive economic zone.

Reptiles are likely able to detect low-frequency components of broadband continuous vessel noise which may elicit masking, physiological stress, or behavioral reactions, including avoidance behavior. The size and severity of these impacts would be insignificant, and not rise to the level of measurable impacts. Because impacts on individual sea turtles, crocodilians, and terrapins, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Accordingly, there would be no consequences to any sea turtle, crocodilian, or terrapin populations.

Pursuant to the ESA, vessel noise produced during testing activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead turtles, and the ESA-listed American crocodile. There would be no effect on green, hawksbill, or leatherback turtle critical habitat or on American crocodile critical habitat. Vessel noise produced during testing activities may affect loggerhead constricted migratory habitats in the mid-Atlantic and southeast regions. The Navy has consulted with NMFS and USFWS as required by section 7(a)(2) of the ESA.

3.8.3.1.5.3 Impacts from Vessel Noise under Alternative 2

Impacts from Vessel Noise under Alternative 2 for Training Activities

While there would be an increase in the amount of at-sea vessel time during training under Alternative 2, the general locations and types of effects due to vessel noise would be the same as described in Alternative 1. Therefore, the general locations and types of effects due to vessel noise described above for training under Alternative 1 would be similar under Alternative 2. Navy vessel noise would continue to be a minor contributor to overall radiated vessel noise in the exclusive economic zone.

Reptiles are likely able to detect low-frequency components of broadband continuous vessel noise which may elicit masking, physiological stress, or behavioral reactions, including avoidance behavior. The size and severity of these impacts would be insignificant, and not rise to the level of measurable impacts. Because impacts on individual sea turtles, crocodilians, and terrapins, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Accordingly, there would be no consequences to any sea turtle, crocodilian, or terrapin populations.

Pursuant to the ESA, vessel noise produced during training activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead turtles and the ESA-listed American crocodile. There would be no effect on green, hawksbill, or leatherback turtle critical habitat or on American crocodile critical habitat. Vessel noise produced during training activities may affect loggerhead constricted migratory habitats in the mid-Atlantic and southeast regions.

Impacts from Vessel Noise under Alternative 2 for Testing Activities

As discussed in Chapter 2 (Description of Proposed Action and Alternatives), testing activities under Alternative 2 include vessel movement during many events. The difference in vessel noise contributed by testing activities under Alternative 2 compared to Alternative 1 is so small as to not be discernable. Therefore, the general locations and types of effects due to vessel noise described above for testing under Alternative 1 would be the same under Alternative 2. Navy vessel noise would continue to be a minor contributor to overall radiated vessel noise in the exclusive economic zone.

Reptiles are likely able to detect low-frequency components of broadband continuous vessel noise which may elicit masking, physiological stress, or behavioral reactions, including avoidance behavior. The size and severity of these impacts would be insignificant, and not rise to the level of measurable impacts. Because impacts on individual sea turtles, crocodilians, and terrapins if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Accordingly, there would be no consequences to any sea turtle, crocodilian, or terrapin populations.

Pursuant to the ESA, vessel noise produced during testing activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead turtles and the ESA-listed American crocodile. There would be no effect on green, hawksbill, or leatherback turtle critical habitat or American crocodile critical habitat. Vessel noise produced during testing activities may affect loggerhead constricted migratory habitats in the mid-Atlantic and southeast regions.

3.8.3.1.5.4 Impacts from Vessel Noise under the No Action Alternative

Under the No-Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various acoustic stressors (e.g., vessel noise) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.8.3.1.6 Impacts from Aircraft Noise

Fixed and rotary-wing aircraft are used during a variety of training and testing activities throughout the Study Area. Aircraft produce extensive airborne noise from either turbofan or turbojet engines. Rotary-wing aircraft (helicopters) produce low-frequency sound and vibration (Pepper et al., 2003). An infrequent type of aircraft noise is the sonic boom, produced when the aircraft exceeds the speed of sound. Fixed-wing aircraft would pass quickly overhead, while rotary-wing aircraft (e.g., helicopters) may hover at lower altitudes for longer durations. A description of aircraft noise produced during Navy activities is provided in Section 3.0.3.3.1.5 (Aircraft Noise), including estimates of underwater noise produced by certain flight activities. Aircraft flights during training would be most concentrated within the offshore waters of the Virginia Capes, Navy Cherry Point, Jacksonville, and Key West Range Complexes. The use of aircrafts during training activities would also occur within several inshore water locations, but would be concentrated within the James Rivers and tributaries; Lower Chesapeake Bay; Kings Bay, Georgia; and Port Canaveral, Florida.

Most in-air sound would be reflected at the air-water interface. Depending on atmospheric conditions, in-air sound can refract upwards, limiting the sound energy that reaches the water surface. This is especially true for sounds produced at higher altitudes. Underwater sounds from aircraft would be strongest just below the surface and directly under the aircraft. Any sound that does enter the water only does so within a narrow cone below the sound source that would move with the aircraft. For the common situation of a hovering helicopter, the sound pressure level in water would be about 125 dB re

1 µPa for an H-60 helicopter hovering at 50 ft. For an example fixed-wing flight, the sound pressure underwater would be about 128 dB re 1 µPa for an F/A-18 traveling at 250 knots at 3,000 ft. altitude. Most air combat maneuver activities would occur at higher altitudes. Supersonic aircraft, if flying at low altitudes, could generate an airborne sonic boom that may be sensed by reptiles while at the surface, or as a low-level impulsive sound underwater.

3.8.3.1.6.1 Methods for Analyzing Impacts from Aircraft Noise

The amount of sound entering the ocean from aircraft would be very limited in duration, sound level, and affected area. For those reasons, impacts on sea turtles and other aquatic reptiles from aircraft have not been studied. Due to the low level of sound that could enter the water from aircraft, hearing loss is not further considered as a potential effect. Potential impacts considered are masking of other biologically relevant sounds, physiological stress, and changes in behavior.

There is little information with which to assess behavioral responses of reptiles to aircraft. The *ANSI Sound Exposure Guidelines* for sea turtles did not consider this acoustic stressor (Popper et al., 2014). For this analysis, the Navy assumes that some animals at or near the water surface may exhibit startle reactions to certain aircraft noise if aircraft altitude is low. This could mean a hovering helicopter, for which the sight of the aircraft and water turbulence could also cause a response, or a low-flying or super-sonic aircraft generating enough noise to be briefly detectable underwater or at the air-water interface. Because any fixed-wing or missile overflight would be brief, the risk of masking any sounds relevant to reptiles is very low.

Since crocodilians and terrapins have similar hearing range and sensitivity as sea turtles, as described in Section 3.8.2.1.4 (Hearing and Vocalization), it is inferred that crocodilians and terrapins would react similarly to aircraft noise as sea turtles.

3.8.3.1.6.2 Impacts from Aircraft Noise under Alternative 1

Impacts from Aircraft Noise under Alternative 1 for Training Activities

Characteristics of aircraft noise are described in Section 3.0.3.3.1 (Acoustic Stressors), and the number of training activities that include aircraft under Alternative 1 are shown in Section 3.0.3.3.4.4 (Aircraft). Training activities with aircraft would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). Aircraft noise would usually occur adjacent to Navy airfields, installations, and in special use airspace within Navy range complexes. Aircraft flights during training would be most concentrated within the Virginia Capes, Navy Cherry Point, Jacksonville, and Key West Range Complexes.

Reptiles may respond to both the physical presence and to the noise generated by aircraft, making it difficult to attribute causation to one or the other stimulus. In addition to noise produced, all low-flying aircraft make shadows, which can cause animals at the surface to react. Helicopters may also produce strong downdrafts, a vertical flow of air that becomes a surface wind, which can also affect an animal's behavior at or near the surface.

In most cases, exposure of a reptile to fixed-wing aircraft presence and noise would be brief as the aircraft quickly passes overhead. Animals would have to be at or near the surface at the time of an overflight to be exposed to appreciable sound levels. Supersonic flight at sea would not be conducted over crocodilian or terrapin habitats, and is typically conducted at altitudes exceeding 30,000 ft., limiting the number of occurrences of supersonic flight being audible at the water surface. Because most overflight exposures from fixed-wing aircraft or transiting helicopters would be brief and aircraft noise would be at low received levels, only startle reactions, if any, are expected in response to low altitude flights. Similarly, the brief duration of most overflight exposures would limit any potential for masking of relevant sounds.

Daytime and nighttime activities involving helicopters may occur for extended periods of time, up to a couple of hours in some areas. During these activities, helicopters would typically transit throughout an area and may hover over the water. Longer activity durations and periods of time where helicopters hover may increase the potential for behavioral reactions, startle reactions, and physiological stress. Low-altitude flights of helicopters during some activities, which often occur under 100 ft. altitude, may elicit a stronger startle response due to the proximity of a helicopter to the water; the slower airspeed and longer exposure duration; and the downdraft created by a helicopter's rotor.

Most fixed-wing aircraft and helicopter activities are transient in nature, although helicopters could also hover for extended periods. The likelihood that a sea turtle, crocodilian, or terrapin would occur or remain at the surface while an aircraft or helicopter transits directly overhead would be low. Helicopters that hover in a fixed location for an extended period of time could increase the potential for exposure. However, impacts from training and testing activities would be highly localized and concentrated in space and duration.

Behavioral reactions, startle reactions, and physiological stress due to aircraft noise, including hovering helicopters, are likely to be brief and minor, if they occur at all. Sea turtle reactions to aircraft noise have not been studied like marine mammals. For marine mammals, aircraft noise would cause only small temporary changes in behavior. Since reptile hearing is less sensitive than marine mammals, conservatively, it is likely that sea turtles, crocodilians, and terrapins could exhibit temporary changes in behavior to aircraft noise as well. The size and severity of these impacts would be insignificant, and not rise to the level of measurable impacts.

Aircraft noise during training activities would not overlap with green, hawksbill, or leatherback turtle critical habitat around Culebra, Puerto Rico; Mona Island, Puerto Rico; and St. Croix Island, U.S. Virgin Islands respectively. Loggerhead turtle critical habitat would not be affected by aircraft noise above the water.

It is reasonable to assume that crocodilians and terrapins use their hearing similarly to sea turtles and that the types of impacts would be similar to those described above for sea turtles. Within their respective geographic ranges, crocodilians and terrapins could potentially be exposed to aircraft noise in the inshore regions of the Study Area during training activities, as described in Appendix A (Navy Activity Descriptions). Navy aircraft presence would be unlikely in American crocodile habitat, which consists of shallow nearshore habitat in southern Florida; however, it is possible that American crocodiles could be occasionally exposed to Navy aircraft noise. Aircraft noise would not impact American crocodile critical habitat in Florida Bay which encompasses creeks, canals, and swamps.

Because impacts on individual sea turtles, crocodilians, or terrapins, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Accordingly, there would be no consequences to any sea turtle, crocodilian, or terrapin populations.

Pursuant to the ESA, aircraft noise produced during training activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp’s ridley, leatherback, and loggerhead turtles and the ESA-listed American crocodile. Aircraft noise during training activities would have no effect on green, hawksbill, leatherback, or loggerhead turtle critical habitat or American crocodile critical habitat. The Navy has consulted with NMFS and USFWS as required by section 7(a)(2) of the ESA.

Impacts from Aircraft Noise under Alternative 1 for Testing Activities

Characteristics of aircraft noise are described in Section 3.0.3.3.1 (Acoustic Stressors) and the number of testing activities with aircraft under Alternative 1 are shown in Section 3.0.3.3.4.4 (Aircraft). Testing activities using aircraft would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). Aircraft overflights would usually occur adjacent to Navy airfields, installations, and in special use airspace within Navy range complexes. Testing activities with aircraft would be most concentrated within the offshore waters of the Northeast, Navy Cherry Point, Virginia Capes, and Jacksonville Range Complexes.

Testing activities under Alternative 1 use aircraft during numerous events. Because many testing activities would use the same or similar aircraft as Navy training events in the same general locations, the types of effects due to aircraft noise described above for training would be similar for many testing activities. Because impacts on individual reptiles, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Accordingly, there would be no consequences to any reptile populations.

Pursuant to the ESA, aircraft noise produced during testing activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead turtles and the ESA-listed American crocodile. There would be no effect on green, hawksbill, leatherback or loggerhead turtle critical habitat or American crocodile critical habitat. The Navy has consulted with NMFS and USFWS as required by section 7(a)(2) of the ESA.

3.8.3.1.6.3 Impacts from Aircraft Noise under Alternative 2

Impacts from Aircraft Noise under Alternative 2 for Training Activities

There would be a minor increase in aircraft noise during training activities under Alternative 2 compared to Alternative 1; however, the types of impacts would not be discernible from those described for training under Alternative 1. Because impacts on individual sea turtles, crocodilians, or terrapins, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Accordingly, there would be no consequences to any sea turtle, crocodilian, or terrapin populations.

Pursuant to the ESA, aircraft noise produced during training activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead turtles and the ESA-listed American crocodile; and would have no effect on green, hawksbill, leatherback, or loggerhead turtle critical habitat or on American crocodile critical habitat.

Impacts from Aircraft Noise under Alternative 2 for Testing Activities

There would be a minor increase in aircraft noise under Alternative 2 compared to Alternative 1; however, the types of impacts would not be discernible from those described for testing under Alternative 1. Impacts on individual sea turtles, crocodilians, or terrapins, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Accordingly, there would be no consequences to any sea turtle, crocodilian, or terrapin populations.

Pursuant to the ESA, aircraft noise produced during testing activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, loggerhead, and leatherback turtles and the ESA-listed American crocodile. Aircraft noise produced during testing activities would have no effect on green, hawksbill, leatherback, or loggerhead turtle critical habitat or on American crocodile critical habitat.

3.8.3.1.6.4 Impacts from Aircraft Noise under the No Action Alternative

Under the No-Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various acoustic stressors (e.g., aircraft noise) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.8.3.1.7 Impacts from Weapon Noise

Reptiles may be exposed to sounds caused by the firing of weapons, objects in flight, and inert impact of non-explosive munitions on the water's surface, which are described in Section 3.0.3.3.1.6 (Weapon Noise). In general, these are impulsive sounds generated in close vicinity to or at the water surface, with the exception of items that are launched underwater. The noise generated from firing a weapon include muzzle blast and a crack sound due to a low amplitude shock wave generated by a supersonic projectile flying through the air. Most in-air sound would be reflected at the air-water interface. Underwater sounds would be strongest just below the surface and directly under the firing point. Any sound that enters the water only does so within a narrow cone below the firing point or path of the projectile. Vibration from the blast propagating through a ship's hull, the sound generated by the impact of an object with the water surface, and the sound generated by launching an object underwater are other sources of impulsive sound in the water. Sound due to missile and target launches is typically at a maximum at initiation of the booster rocket and rapidly fades as the missile or target travels downrange.

3.8.3.1.7.1 Methods for Analyzing Impacts from Weapon Noise

The amount of sound entering the ocean from weapon firing, projectile travel, and inert objects hitting the water would be very limited in duration and affected area. Sound levels could be relatively high directly beneath a gun blast, but even in the worst-case scenario of a naval large caliber gun fired at the lowest elevation angle, sound levels in the water directly below the blast (about 200 db re 1 µPa SPL peak; see Yagla & Stiegler, 2003) are substantially lower than necessary to cause hearing loss in a sea turtle. Similarly, situations in which inert objects hitting the water, even at high speeds, could hypothetically generate sound sufficient to cause hearing loss within a short distance would be very rare. Therefore, hearing loss is not further considered as a potential effect. Potential impacts considered are masking of other biologically relevant sounds, physiological stress, and changes in behavior.

Since crocodilians and terrapins have similar hearing range and sensitivity as sea turtles, as described in Section 3.8.2.1.4 (Hearing and Vocalization), it is inferred that crocodilians and terrapins would react similarly to weapon noise as sea turtles.

3.8.3.1.7.2 Impacts from Weapon Noise under Alternative 1

Impacts from Weapon Noise under Alternative 1 for Training Activities

Activities using weapons and deterrents would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). General characteristics of types of weapon noise are described in Section 3.0.3.3.1.6 (Weapon Noise), and quantities and locations of expended non-explosive practice munitions and explosives (fragment-producing) for training under Alternative 1 are shown in Section 3.0.3.3.4.2 (Military Expended Materials). For explosive munitions, only associated firing noise is considered in the analysis of weapon noise. The noise produced by the detonation of explosive weapons is analyzed in Section 3.8.3.2 (Explosive Stressors).

Weapon training would occur in the range complexes, with greatest use of most types of munitions in the Virginia Capes, Navy Cherry Point, and Jacksonville Range Complexes. Most activities involving large-caliber naval gunfire or the launching of targets, missiles, bombs, or other munitions are conducted more than 12 NM from shore, but could potentially occur in the Panama City OPAREA and the Naval Surface Warfare Center Panama City Testing Range. Small- and medium-caliber weapon firing could occur throughout the Study Area. Only small-caliber weapons are used within inshore waters. Navy training activities in the inshore waters occur in several locations along the Atlantic coast as described in Section 3.0.3.3.4.2 (Military Expended Materials), with the highest concentration occurring in the James River and tributaries in Virginia. Other locations include the Lower Chesapeake Bay; Cooper River, South Carolina; Port Canaveral, Florida; and Narragansett, Rhode Island.

All of these sounds would be brief, lasting from less than a second for a blast or inert impact to few seconds for other launch and object travel sounds. Most incidents of impulsive sounds produced by weapon firing, launch, or inert object impacts would be single events, with the exception of gunfire activities. It is expected that these sounds may elicit brief startle reactions or diving, with avoidance being more likely with the repeated exposure to sounds during gunfire events. It is assumed that, similar to air gun exposures, reptile behavioral responses would cease following the exposure event and the risk of a corresponding, sustained stress response would be low. Similarly, exposures to impulsive noise caused by these activities would be so brief that risk of masking relevant sounds would be low. These activities would not typically occur in nearshore habitats where sea turtles may use their limited hearing to sense broadband, coastal sounds. Behavioral reactions, startle reactions, and physiological stress due to weapon noise are likely to be brief and minor, if they occur at all due, to the low probability of co-occurrence between weapon activity and sea turtle individuals.

To further avoid the potential for impacts, the Navy will implement mitigation for weapon firing noise that includes ceasing large-caliber gunnery activities if a sea turtle is observed in the mitigation zone, as discussed in Section 5.3.2 (Acoustic Stressors). Also, activities will not be initiated near concentrated *Sargassum* mats due to the possible presence of sea turtles. This further reduces the likelihood of impacts on hatchling and pre-recruitment juveniles of all sea turtle species and leatherback turtles of all age classes since these species and age classes occur in open-ocean habitat where most of these activities would occur.

Considering the above factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences to sea turtle individuals or populations would not be expected.

Weapon training would not overlap with green, hawksbill, or leatherback turtle critical habitat around Culebra, Puerto Rico; Mona Island, Puerto Rico; and St. Croix Island, U.S. Virgin Islands respectively. For loggerhead critical habitat (79 *Federal Register* 39855), weapon noise during training activities would have a pathway to impact the physical and biological features of the constricted migratory habitat in the mid-Atlantic and southeast regions by producing “noise pollution” from military activity. The impacts on this habitat would be considered insignificant, with no discernible impact on the conservation function of the physical and biological features as activity would not prevent a turtle from migrating, as weapon noise is brief in nature. The physical and biological features of the nearshore reproductive, wintering, breeding, and *Sargassum* habitats (National Marine Fisheries Service, 2014b) would not be impacted by weapon noise during training activities.

It is reasonable to assume that crocodilians and terrapins use their hearing similarly to sea turtles and that the types of impacts would be similar to those described above for sea turtles. Within their respective geographic ranges, crocodilians and terrapins could potentially be exposed to weapon noise in some inshore waters of the Study Area during training activities, as described in Appendix A (Navy Activity Descriptions). Activities producing weapon noise would not occur in American crocodile habitat, which consists of shallow nearshore habitat in southern Florida. Weapon noise would not impact American crocodile critical habitat in Florida Bay which encompasses creeks, canals, and swamps. Because impacts on individual crocodilians and terrapins, if any, are expected to be minor and limited, long-term consequences to individuals or populations would not be expected.

Pursuant to the ESA, weapon noise produced during training activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead turtles; and would have no effect on the ESA-listed American crocodile. There would be no effect on green, hawksbill, or leatherback turtle critical habitat or American crocodile habitat. Weapon noise produced during training activities may affect loggerhead constricted migratory habitats in the mid-Atlantic and southeast regions. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA.

Impacts from Weapon Noise under Alternative 1 for Testing Activities

Activities using weapons and deterrents would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). General characteristics of types of weapon noise are described in Section 3.0.3.3.1.6 (Weapon Noise), and quantities and locations of expended non-explosive practice munitions and explosives (fragment-producing) for testing under Alternative 1 are shown in Section 3.0.3.3.4.2 (Military Expended Materials). For explosive munitions, only associated firing noise is considered in the analysis of weapon noise. The noise produced by the detonation of explosive weapons is analyzed in Section 3.8.3.2 (Explosive Stressors).

The general locations and types of effects due to weapon noise described above for training would be similar for many testing activities. Weapon testing would typically occur on the range complexes, with some activity also occurring on testing ranges. Most activities involving large-caliber naval gunfire or the launching of targets, missiles, bombs, or other munitions are conducted more than 12 NM from shore, but could potentially occur in the Panama City OPAREA and the Naval Surface Warfare Center Panama City Testing Range.

To further avoid the potential for impacts, the Navy will implement mitigation for weapon firing noise that includes ceasing large-caliber gunnery activities if a sea turtle is observed in the mitigation zone, as discussed in Section 5.3.2 (Acoustic Stressors). Also, activities will not be initiated near concentrated *Sargassum* mats due to the possible presence of sea turtles. This further reduces the likelihood of impacts on hatchling and pre-recruitment juveniles of all sea turtle species and leatherback turtles of all age classes since these species and age classes occur in open-ocean habitat where most of these activities would occur.

Considering the above factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences to sea turtle individuals or populations would not be expected. No testing activities would use munitions in inshore waters, and thus would not overlap with or impact crocodilians or terrapins.

Weapon testing would not overlap with green, hawksbill, or leatherback turtle critical habitat around Culebra, Puerto Rico; Mona Island, Puerto Rico; and St. Croix Island, U.S. Virgin Islands respectively. For loggerhead critical habitat (79 *Federal Register* 39855), weapon noise during training activities would have a pathway to impact the physical and biological features of the constricted migratory habitat in the mid-Atlantic and southeast regions by producing “noise pollution” from military activity. The impacts on this habitat would be considered insignificant, with no discernible impact on the conservation function of the physical and biological features as activity would not prevent a turtle from migrating, as weapon noise is brief in nature. The physical and biological features of the nearshore reproductive, wintering, breeding, and *Sargassum* habitats (National Marine Fisheries Service, 2014b) would not be impacted by weapon noise during testing activities.

Activities producing weapon noise would not occur in American crocodile habitat, which consists of shallow nearshore habitat in southern Florida. Weapon noise would not impact American crocodile critical habitat in Florida Bay which encompasses creeks, canals, and swamps.

Pursuant to the ESA, weapon noise produced during testing activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp’s ridley, leatherback, and loggerhead turtles; and would have no effect on the ESA-listed American crocodile. There would be no effect on green, hawksbill, or leatherback sea turtle critical habitat or American crocodile critical habitat. Weapon noise produced during testing activities may affect loggerhead constricted migratory habitats in the mid-Atlantic and southeast regions. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA.

3.8.3.1.7.3 Impacts from Weapon Noise under Alternative 2

Impacts from Weapon Noise under Alternative 2 for Training Activities

Activities using weapons and deterrents would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). General characteristics of types of weapon noise are described in Section 3.0.3.3.1.6 (Weapon Noise), and quantities and locations of expended non-explosive practice munitions and explosives (fragment-producing) for training under Alternative 2 are shown in 3.0.3.3.4.2. (Military Expended Materials). For explosive munitions, only associated firing noise is considered in the analysis of weapon noise. The noise produced by the detonation of explosive weapon is analyzed in Section 3.8.3.2 (Explosive Stressors).

There would be a minor increase in these activities under Alternative 2 compared to Alternative 1; however, the types of impacts and locations of impacts would be the same as those described for training under Alternative 1. To further avoid the potential for impacts, the Navy will implement mitigation for weapon firing noise that includes ceasing large-caliber gunnery activities if a sea turtle is observed in the mitigation zone, as discussed in Section 5.3.2 (Acoustic Stressors). Also, activities will not be initiated near concentrated *Sargassum* mats due to the possible presence of sea turtles. This further reduces the likelihood of impacts on hatchling and pre-recruitment juveniles of all sea turtle species and leatherback turtles of all age classes since these species and age classes occur in open-ocean habitat where most of these activities would occur. Because impacts on individual sea turtles, crocodilians, and terrapins, if any, are expected to be minor and limited, long-term consequences to individuals or populations are not expected.

Pursuant to the ESA, weapon noise produced during training activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp’s ridley, leatherback, and loggerhead turtles; and would have no effect on the ESA-listed American crocodile. There would be no effect on green, hawksbill, or leatherback turtle critical habitat or American crocodile critical habitat. Weapon noise produced during training activities may affect loggerhead constricted migratory habitats in the mid-Atlantic and southeast regions.

Impacts from Weapon Noise under Alternative 2 for Testing Activities

Activities using weapon and deterrents would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). General characteristics of types of weapon noise are described in Section 3.0.3.3.1.6 (Weapon Noise), and quantities and locations of expended non-explosive practice munitions and explosives (fragment-producing) for testing under Alternative 2 are shown in 3.0.3.3.4.2. (Military Expended Materials). For explosive munitions, only associated firing noise is considered in the analysis of weapon noise. The noise produced by the detonation of explosive weapons is analyzed in Section 3.8.3.2 (Explosive Stressors).

There would be a minor increase in these activities under Alternative 2 compared to Alternative 1; however, the types of impacts and locations of impacts would be the same as those described for testing under Alternative 1. To further avoid the potential for impacts, the Navy will implement mitigation for weapon firing noise that includes ceasing large-caliber gunnery activities if a sea turtle is observed in the mitigation zone, as discussed in Section 5.3.2 (Acoustic Stressors). Also, activities will not be initiated near concentrated *Sargassum* mats due to the possible presence of sea turtles. This further reduces the likelihood of impacts on hatchling and pre-recruitment juveniles of all sea turtle species and leatherback turtles of all age classes since these species and age classes occur in open-ocean habitat where most of these activities would occur. No testing activities would use munitions in inshore waters, and thus would not overlap with or impact crocodilians or terrapins.

Because impacts on individual sea turtles, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Accordingly, there would be no consequences to any sea turtle populations. Pursuant to the ESA, weapon noise produced during testing activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead turtles; and would have no effect on the ESA-listed American crocodile. There would be no effect on green, hawksbill, or leatherback turtle critical habitat or American crocodile critical habitat. Weapon noise produced during testing activities may affect loggerhead constricted migratory habitats in the mid-Atlantic and southeast regions.

3.8.3.1.7.4 Impacts from Weapon Noise under the No Action Alternative

Under the No-Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various acoustic stressors (e.g., weapon noise) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.8.3.2 Explosive Stressors

Explosions in the water or near the water surface can introduce loud, impulsive, broadband sounds into the marine environment. But unlike other acoustic stressors, explosions release energy at a high rate producing a shock wave that can be injurious and even deadly. Therefore, explosive impacts on reptiles are discussed separately from other acoustic stressors, even though the analysis of explosive impacts will rely on data for sea turtle impacts due to impulsive sound exposure where appropriate.

Explosives are usually described by their net explosive weight, which accounts for the weight and type of explosive material. Additional explanation of the acoustic and explosive terms and sound energy concepts used in this section is found in Appendix D (Acoustic and Explosives Concepts).

This section begins with a summary of relevant data regarding explosive impacts on reptiles in Section 3.8.3.2.1 (Background). The ways in which an explosive exposure could result in immediate effects or lead to long-term consequences for an animal are explained in the Section 3.0.3.6.1 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities), and the analysis in this section follows that framework. Studies of the effects of sound and explosives on reptiles are limited; therefore, where necessary, knowledge of explosive impacts to other species is used to assess impacts on reptiles, such as sea turtles, crocodilians, and terrapins.

3.8.3.2.1 Background

The sections below include a survey and synthesis of best available science published in peer-reviewed journals, technical reports, and other scientific sources pertinent to impacts on reptiles potentially resulting from Navy training and testing activities. Reptiles could be exposed to a range of impacts depending on the explosive source and context of the exposure. In addition to acoustic impacts including temporary or permanent hearing loss, auditory masking, physiological stress, or changes in behavior, potential impacts from an explosive exposure can include non-lethal injury and mortality.

3.8.3.2.1.1 Injury

Because direct studies of explosive impacts on reptiles have not been conducted, the below discussion of injurious effects is based on studies of other animals, generally mammals. The generalizations that can be made about in-water explosive injuries to other species should be applicable to reptiles, with consideration of the unique anatomy of sea turtles and terrapins. For example, it is unknown if the sea turtle shell may afford it some protection from internal injury.

If an animal is exposed to an explosive blast underwater, the likelihood of injury depends on the charge size, the geometry of the exposure (distance to the charge, depth of the animal and the charge), and the size of the animal. In general, an animal would be less susceptible to injury near the water surface because the pressure wave reflected from the water surface would interfere with the direct path pressure wave, reducing positive pressure exposure. However, rapid under-pressure caused by the negative surface-reflected pressure wave above an underwater detonation may create a zone of cavitation that may contribute to potential injury. In general, blast injury susceptibility would increase with depth, until normal lung collapse (due to increasing hydrostatic pressure) and increasing ambient pressures again reduce susceptibility. See Appendix D (Acoustic and Explosives Concepts) for an overview of explosive propagation and an explanation of explosive effects on gas cavities.

Primary blast injury is injury that results from the compression of a body exposed to a blast wave. This is usually observed as barotrauma of gas-containing structures (e.g., lung and gut) and structural damage to the auditory system (Greaves et al., 1943; Office of the Surgeon General, 1991; Richmond et al., 1973). The lungs are typically the first site to show any damage, while the solid organs (e.g., liver, spleen, and kidney) are more resistant to blast injury (Clark & Ward, 1943). Recoverable injuries would include slight lung injury, such as capillary interstitial bleeding, and contusions to the gastrointestinal tract. More severe injuries would significantly reduce fitness and likely cause death in the wild. Rupture of the lung may also introduce air into the vascular system, producing air emboli that can cause a stroke or heart attack by restricting oxygen delivery to critical organs. In this discussion, primary blast injury to auditory tissues is considered gross structural tissue injury distinct from noise-induced hearing loss, which is considered below in Section 3.8.3.2.1.2 (Hearing Loss).

Data on observed injuries to sea turtles from explosions is generally limited to animals found following explosive removal of offshore structures (Viada et al., 2008), which can attract sea turtles for feeding opportunities or shelter. Klima et al. (1988) observed a turtle mortality subsequent to an oil platform removal blast, although sufficient information was not available to determine the animal's exposure. Klima et al. (1988) also placed small sea turtles (less than seven kilograms) at varying distances from piling detonations. Some of the turtles were immediately knocked unconscious or exhibited vasodilation over the following weeks, but others at the same exposure distance exhibited no effects.

Incidental injuries to sea turtles due to military explosions have been documented in a few instances. In one incident, a single 1,200 pound (lb.) trinitrotoluene (TNT) underwater charge was detonated off Panama City, FL in 1981. The charge was detonated at a mid-water depth of 120 ft. Although details are limited, the following were recorded: at a distance of 500–700 ft., a 400 lb. sea turtle was killed; at 1,200 ft., a 200–300 lb. sea turtle experienced "minor" injury; and at 2,000 ft. a 200–300 lb. sea turtle was not injured (O'Keeffe & Young, 1984). In another incident, two "immature" green sea turtles (size unspecified) were killed when 100-150 ft. away from detonation of 20 lb. of C-4 in a shallow water environment.

For this analysis, it is assumed that these types of observations would also apply to crocodilians and terrapins. Results from limited experimental data suggest two explosive metrics are predictive of explosive injury: peak pressure and impulse.

Impulse as a Predictor of Explosive Injury

Without measurements of the explosive exposures in the above incidents, it is difficult to draw conclusions about what amount of explosive exposure would be injurious to aquatic reptiles. Studies of observed in-water explosive injuries showed that terrestrial mammals were more susceptible than comparably sized fish with swim bladders (Yelverton & Richmond, 1981), and that fish with swim bladders may have increased susceptibility to swim bladder oscillation injury depending on exposure geometry (Goertner, 1978; Wiley et al., 1981). Therefore, controlled tests with a variety of terrestrial mammals (mice, rats, dogs, pigs, sheep, and other species) are the best available data sources on actual injury to similar-sized animals due to underwater exposure to explosions.

In the early 1970s, the Lovelace Foundation for Medical Education and Research conducted a series of tests in an artificial pond to determine the effects of underwater explosions on mammals, with the goal of determining safe ranges for human divers. The resulting data were summarized in two reports (Richmond et al., 1973; Yelverton et al., 1973). Specific physiological observations for each test animal are documented in Richmond et al. (1973). Gas-containing internal organs, such as lungs and intestines, were the principle damage sites in submerged terrestrial mammals, consistent with earlier studies of mammal exposures to underwater explosions (Clark & Ward, 1943; Greaves et al., 1943).

In the Lovelace studies, acoustic impulse was found to be the metric most related to degree of injury, and size of an animal's gas-containing cavities was thought to play a role in blast injury susceptibility. The proportion of lung volume to overall body size is similar between sea turtles and terrestrial mammals, so the magnitude of lung damage in the tests may approximate the magnitude of injury to sea turtles when scaled for body size. Measurements of some shallower diving sea turtles (Hochscheid et al., 2007) show lung to body size ratios that are larger than terrestrial animals, whereas the lung to body mass ratio of the deeper diving leatherback sea turtle is smaller (Lutcavage et al., 1992). The use of test data with smaller lung to body ratios to set injury thresholds may result in a more conservative estimate of potential for damaging effects (i.e., lower thresholds) for animals with larger lung to body ratios.

For these shallow exposures of small terrestrial mammals (masses ranging from 3.4 to 50 kilograms) to underwater detonations, Richmond et al. (1973) reported that no blast injuries were observed when exposures were less than 6 lb. per square in. per millisecond (psi-ms) (40 pascal-seconds [Pa-s]), no instances of slight lung hemorrhage occurred below 20 psi-ms (140 Pa-s), and instances of no lung damage were observed in some exposures at higher levels up to 40 psi-ms (280 Pa-s). An impulse of 34 psi-ms (230 Pa-s) resulted in about 50 percent incidence of slight lung hemorrhage. About half of the animals had gastrointestinal tract contusions (with slight ulceration, i.e., some perforation of the mucosal layer) at exposures of 25–27 psi-ms (170–190 Pa-s). Lung injuries were found to be slightly more prevalent than gastrointestinal tract injuries for the same exposure.

The Lovelace subject animals were exposed near the water surface; therefore, depth effects were not discernible in this data set. In addition, this data set included only small terrestrial animals, whereas adult reptiles may be substantially larger and have respiratory structures adapted for the high pressures experienced at depth. Goertner (1982) examined how lung cavity size would affect susceptibility to blast injury by considering both size and depth in a bubble oscillation model of the lung, which is assumed to be applicable to reptiles as well for this analysis. Animal depth relates to injury susceptibility in two ways: injury is related to the relative increase in explosive pressure over hydrostatic pressure, and lung collapse with depth reduces the potential for air cavity oscillatory damage. The time period over which an impulse must be delivered to cause damage is assumed to be related to the natural oscillation period of an animal’s lung, which depends on lung size. Based on a study of green sea turtles, Berkson (1967) predicted sea turtle lung collapse would be complete around 80–160 m depth.

Peak Pressure as a Predictor of Explosive Trauma

High instantaneous peak pressures can cause damaging tissue distortion. Goertner (1982) suggested a peak overpressure gastrointestinal tract injury criterion because the size of gas bubbles in the gastrointestinal tract are variable, and their oscillation period could be short relative to primary blast wave exposure duration. The potential for gastrointestinal tract injury, therefore, may not be adequately modeled by the single oscillation bubble methodology used to estimate lung injury due to impulse. Like impulse, however, high instantaneous pressures may damage many parts of the body, but damage to the gastrointestinal tract is used as an indicator of any peak pressure-induced injury due to its vulnerability.

Older military reports documenting exposure of human divers to blasts generally describe peak pressure exposures around 100 lb. per square inch (psi) (237 dB re 1 µPa peak) to feel like a slight pressure or stinging sensation on skin, with no enduring effects (Christian & Gaspin, 1974). Around 200 psi, the shock wave felt like a blow to the head and chest. Data from the Lovelace Foundation experiments show instances of gastrointestinal tract contusions after exposures up to 1,147 psi peak pressure, while exposures of up to 588 psi peak pressure resulted in many instances of no observed gastrointestinal tract effects. The lowest exposure for which slight contusions to the gastrointestinal tract were reported was 237 dB re 1 µPa peak. As a vulnerable gas-containing organ, the gastrointestinal tract is vulnerable to both high peak pressure and high impulse, which may vary to differing extents due to blast exposure conditions (e.g., animal depth, distance from the charge). This likely explains the range of effects seen at similar peak pressure exposure levels and shows the utility of considering both peak pressure and impulse when analyzing the potential for injury due to explosions.

The *ANSI Sound Exposure Guidelines* (Popper et al., 2014) recommended peak pressure guidelines for sea turtle injury from explosives. Lacking any direct data for sea turtles, these recommendations were based on fish data. Of the fish data available, the working group conservatively chose the study with the lowest peak pressures associated with fish mortality to set guidelines (Hubbs & Rechnitzer, 1952), and did not consider the Lovelace studies discussed above.

Fragmentation

Fragments produced by exploding munitions at or near the surface may present a high-speed strike hazard for an animal at or near the surface. In water, however, fragmentation velocities decrease rapidly due to drag (Swisdak & Montanaro, 1992). Because blast waves propagate efficiently through water, the range to injury from the blast wave would likely extend beyond the range of fragmentation risk.

3.8.3.2.1.2 Hearing Loss

An underwater explosion produces broadband, impulsive sound that can cause noise-induced hearing loss, typically quantified as threshold shift, which persists after cessation of the noise exposure. This noise-induced hearing loss may manifest as TTS or PTS. Because studies on inducing threshold shift in reptiles are very limited (e.g., alligator lizards: Dew et al., 1993; Henry & Mulroy, 1995) and have not been conducted on any of the reptiles present in the Study Area, auditory threshold shift in reptiles is considered to be consistent with general knowledge about noise-induced hearing loss described in Section 3.0.3.6.1 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities).

Little is known about how sea turtles or terrapins use sound in their environment. The *ANSI Sound Exposure Guidelines* (Popper et al., 2014) do not suggest numeric sound exposure thresholds for auditory effects on sea turtles due to the lack of data. Rather, the guidelines qualitatively advise that sea turtles are less likely to incur TTS or PTS with increasing distance from an explosion. The guidelines also suggest that data from fishes may be more relevant than data from marine mammals when estimating auditory impacts on sea turtles, because, in general, fish hearing range is more similar to the limited hearing range of sea turtles. As shown in Section 3.8.2.1.4.1 (Hearing and Vocalization – Sea Turtles), sea turtle hearing is most sensitive around 100–400 Hz in-water, is limited over 1 kHz, and is much less sensitive than that of any marine mammal. The guidelines do not advise on crocodilians or terrapins, however hearing is most sensitive at low frequencies in these species as discussed in Section 3.8.2.1.4 (Hearing and Vocalization). For this analysis, it is assumed that hearing loss in crocodilians and terrapins would be similar to sea turtles.

3.8.3.2.1.3 Physiological Stress

A stress response is a suite of physiological changes that are meant to help an organism mitigate the impact of a stressor. If the magnitude and duration of the stress response is too great or too long, it can have negative consequences to the animal (e.g., decreased immune function, decreased reproduction). Physiological stress is typically analyzed by measuring stress hormones, other biochemical markers, or vital signs. Physiological stress has been measured for sea turtles during nesting (Flower et al., 2015; Valverde et al., 1999) and capture and handling (Flower et al., 2015; Gregory & Schmid, 2001), but the stress caused by acoustic exposure has not been studied for reptiles. Therefore, the stress response in reptiles in the Study Area due to acoustic exposures is considered to be consistent with general knowledge about physiological stress responses described in Section 3.0.3.6.1 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities).

Marine animals naturally experience stressors within their environment and as part of their life histories. Changing weather and ocean conditions, exposure to diseases and naturally occurring toxins, lack of prey availability, social interactions with members of the same species, nesting, and interactions with predators all contribute to stress. Anthropogenic sound-producing activities have the potential to provide additional stressors beyond those that naturally occur.

Due to the limited information about acoustically induced stress responses in reptiles, the Navy conservatively assumes in its effect analysis that any physiological response (e.g., hearing loss or injury) or significant behavioral response is also associated with a stress response.

3.8.3.2.1.4 Masking

As described in Section 3.0.3.6.1 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities), auditory masking occurs when one sound, distinguished as the "noise," interferes with the detection or recognition of another sound or limits the distance over which other biologically relevant sounds can be detected. Masking only occurs when the sound source is operating; therefore, direct masking effects stop immediately upon cessation of the sound-producing activity. Any unwanted sound above ambient noise and within an animal's hearing range may potentially cause masking that can interfere with an animal's ability to detect, understand, or recognize biologically relevant sounds of interest.

Masking occurs in all vertebrate groups and can effectively limit the distance over which an animal can communicate and detect biologically relevant sounds. The effect of masking has not been studied for marine reptiles. The potential for masking in reptiles would be limited to certain sound exposures due to their limited hearing range to broadband low-frequency sounds and lower sensitivity to noise in the marine environment. Only sounds that have a significant low-frequency component, are not of brief duration, and are of sufficient received level could create a meaningful masking situation. While explosions produce intense, broadband sounds with significant low-frequency content, these sounds are very brief with limited potential to mask relevant sounds.

There is evidence that reptiles may rely primarily on senses other than hearing for interacting with their environment, such as vision (Narazaki et al., 2013), magnetic orientation (Avens, 2003; Putman et al., 2015b), and scent (Shine et al., 2004). Any effect of masking may be mediated by reliance on other environmental inputs.

3.8.3.2.1.5 Behavioral Reactions

There are no observations of behavioral reactions by aquatic reptiles to exposure to explosive sounds and energy. Impulsive signals, particularly at close range, have a rapid rise time and higher instantaneous peak pressure than other signal types, making them more likely to cause startle responses or avoidance responses. Although explosive sources are more energetic than air guns, the few studies of sea turtles' responses to air guns may show the types of behavioral responses that sea turtles may have towards explosions. General research findings regarding behavioral reactions from sea turtles due to exposure to impulsive sounds, such as those associated with explosions, are discussed in detail in Behavioral Reactions to Impulsive Sound Sources under Section 3.8.3.1 (Acoustic Stressors). For this analysis, it is assumed that these guidelines would also apply to crocodilians and terrapins.

3.8.3.2.1.6 Long-Term Consequences

For reptiles present in the Study Area, long-term consequences to individuals and populations due to acoustic exposures have not been studied. Therefore, long-term consequences to reptiles due to explosive exposures are considered following Section 3.0.3.6.1 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities).

Long-term consequences to a population are determined by examining changes in the population growth rate. Physical effects that could lead to a reduction in the population growth rate include mortality or injury, which could remove animals from the reproductive pool, and permanent hearing impairment, which could impact navigation. The long-term consequences due to individual behavioral reactions and short-term instances of physiological stress are especially difficult to predict because individual experience over time can create complex contingencies. It is more likely that any long-term consequences to an individual would be a result of costs accumulated over a season, year, or life stage due to multiple behavioral or stress responses resulting from exposures to multiple stressors over significant periods of time. Conversely, some reptiles may habituate to or become tolerant of repeated acoustic exposures over time, learning to ignore a stimulus that in the past did not accompany any overt threat. For example, loggerhead sea turtles exposed to air guns with a source SPL of 179 dB re 1 µPa initially exhibited avoidance reactions. However, they may have habituated to the sound source after multiple exposures since a habituation behavior was retained when exposures were separated by several days (Moein Bartol et al., 1995). More research is needed to better understand the long-term consequences of human-made noise on reptiles, although intermittent exposures are assumed to be less likely to have lasting consequences.

3.8.3.2.2 Impacts from Explosives

This section analyzes the impacts on reptiles due to in-water explosions that result from Navy training and testing activities, synthesizing the background information presented above.

3.8.3.2.2.1 Methods for Analyzing Impacts from Explosives

Potential impacts considered are mortality, injury, hearing loss due to threshold shift (permanent or temporary), masking of other biologically relevant sounds, physiological stress, and changes in behavior. The Navy's quantitative analysis to determine impacts to sea turtles and marine mammals uses the Navy Acoustic Effects Model to produce initial estimates of the number of animals that may experience these effects; these estimates are further refined by considering animal avoidance of sound-producing activities and implementation of mitigation. The steps of this quantitative analysis are described in Section 3.0.1.2 (Navy's Quantitative Analysis to Determine Impacts to Sea Turtles and Marine Mammals), which takes into account:

- criteria and thresholds used to predict impacts from explosives (see below);
- the density and spatial distribution of sea turtles; and
- the influence of environmental parameters (e.g., temperature, depth, salinity) on sound propagation and explosive energy when estimating the received sound level and pressure on the animals.

A further detailed explanation of this analysis is provided in the technical report titled *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2018).

Since crocodilians and terrapins have similar hearing range and sensitivity as sea turtles, as described in Section 3.8.2.1.4 (Hearing and Vocalization), it is inferred that crocodilians and terrapins would react similarly to explosions as sea turtles.

Criteria and Thresholds used to Predict Impacts from Explosives

Mortality and Injury from Explosives

As discussed above in Section 3.8.3.2.1.1 (Injury), two metrics have been identified as predictive of injury: impulse and peak pressure. Peak pressure contributes to the "crack" or "stinging" sensation of a blast wave, compared to the "thump" associated with received impulse. Older military reports documenting exposure of human divers to blast exposure generally describe peak pressure exposures around 100 psi (237 dB re 1 µPa SPL peak) to feel like slight pressure or stinging sensation on skin, with no enduring effects (Christian & Gaspin, 1974).

Two sets of thresholds are provided for use in non-auditory injury assessment. The exposure thresholds are used to estimate the number of animals that may be affected during Navy training and testing activities (Table 3.8-5). The thresholds for the farthest range to effect are based on the received level at which 1 percent risk is predicted and are useful for assessing mitigation effectiveness. Increasing animal mass and increasing animal depth both increase the impulse thresholds (i.e., decrease susceptibility), whereas smaller mass and decreased animal depth reduce the impulse thresholds (i.e., increase susceptibility). For impact assessment, sea turtle populations are assumed to be 5 percent adult and 95 percent sub-adult. This adult to sub-adult population ratio is estimated from what is known about the population age structure for sea turtles. Sea turtles typically lay multiple clutches of 100 or more eggs with little parental investment and generally have low survival in early life. However, sea turtles that are able to survive past early life generally have high age-specific survival in later life.

Table 3.8-5: Criteria to Quantitatively Assess Non-Auditory Injury due to Underwater Explosions

Impact Category	Impact Threshold	Threshold for Farthest Range to Effect[2]
Mortality[1]	$144M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/6}$ Pa-s	$103M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/6}$ Pa-s
Injury[1]	$65.8\mathrm{M}^{1/3}\left(1+\frac{\mathrm{D}}{10.1}\right)^{1/6}$ Pa-s	$47.5\mathrm{M}^{1/3}\left(1+\frac{\mathrm{D}}{10.1}\right)^{1/6}$ Pa-s
	243 dB re 1 µPa SPL peak	237 dB re 1 µPa SPL peak

[1] Impulse delivered over 20% of the estimated lung resonance period. See U.S. Department of the Navy (2017).
[2] Threshold for 1% risk used to assess mitigation effectiveness.
Note: dB re 1 µPa = decibels referenced to 1 micropascal, SPL = sound pressure level

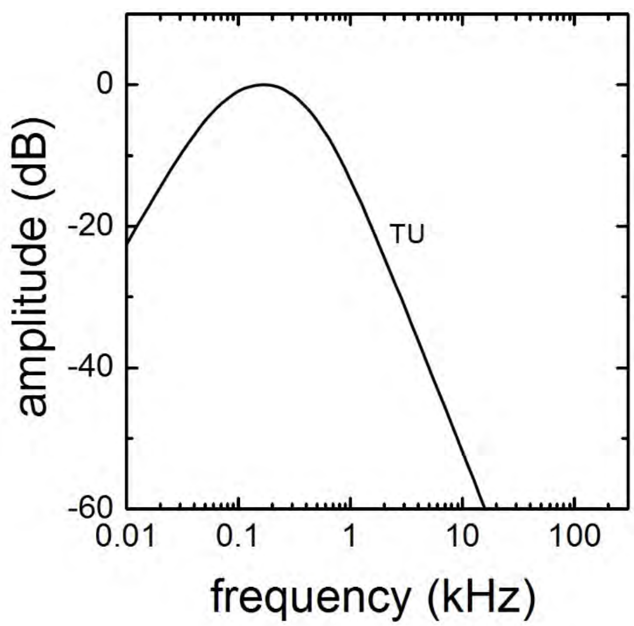
The derivation of these injury criteria and the species mass estimates are provided in the technical report *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (U.S. Department of the Navy, 2017).

When explosive munitions (e.g., a bomb or missile) detonates, fragments of the weapon are thrown at high velocity from the detonation point, which can injure or kill sea turtles if they are struck. Risk of fragment injury reduces exponentially with distance as the fragment density is reduced. Fragments underwater tend to be larger than fragments produced by in-air explosions (Swisdak & Montanaro, 1992). Underwater, the friction of the water would quickly slow these fragments to a point where they no longer pose a threat. On the other hand, the blast wave from an explosive detonation moves efficiently through the seawater. Because the ranges to mortality and injury due to exposure to the blast wave are likely to far exceed the zone where fragments could injure or kill an animal, the above thresholds are assumed to encompass risk due to fragmentation.

Auditory Weighting Functions

Animals are not equally sensitive to noise at all frequencies. To capture the frequency-dependent nature of the effects of noise, auditory weighting functions are used. Auditory weighting functions are mathematical functions that adjust received sound levels to emphasize ranges of best hearing and de-emphasize ranges with less or no auditory sensitivity. The adjusted received sound level is referred to as a weighted received sound level.

The auditory weighting function for sea turtles is shown in Figure 3.8-20. The derivation of this weighting function is described in the technical report *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (U.S. Department of the Navy, 2017). The frequencies around the top portion of the function, where the amplitude is closest to zero, are emphasized, while the frequencies below and above this range (where amplitude declines) are de-emphasized, when summing acoustic energy received by a sea turtle.

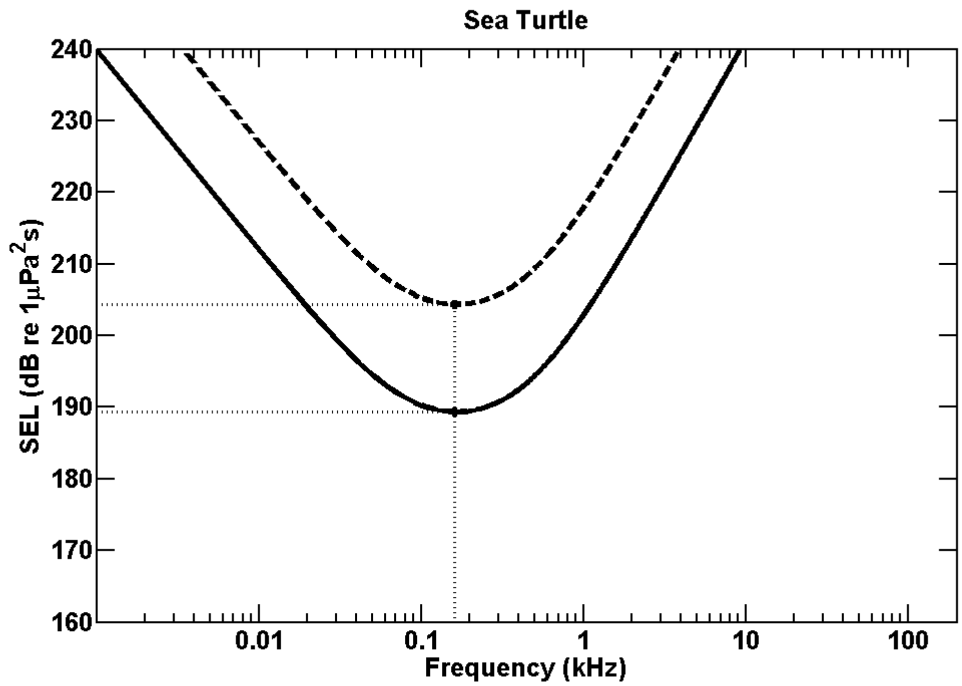


Source: U.S. Department of the Navy (2017)
Notes: dB: decibels; kHz: kilohertz; TU: sea turtle hearing group

Figure 3.8-20: Auditory Weighting Function for Sea Turtles

Hearing Loss from Explosives

No studies of hearing loss have been conducted on sea turtles. Therefore, sea turtle susceptibility to hearing loss due to an acoustic exposure is evaluated using knowledge about sea turtle hearing abilities in combination with non-impulsive auditory effect data from other species (marine mammals and fish). This yields sea turtle exposure functions, shown in Figure 3.8-21, which are mathematical functions that relate the SELs for onset of TTS or PTS to the frequency of the sonar sound exposure. The derivation of the sea turtle exposure functions are provided in the technical report *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (U.S. Department of the Navy, 2017).



Notes: kHz: kilohertz; SEL: Sound Exposure Level, dB re 1 μPa²s = decibels referenced to 1 micropascal squared second. The solid black curve is the exposure function for TTS onset and the dashed black curve is the exposure function for PTS onset. Small dashed lines and asterisks indicate the SEL thresholds and most-sensitive frequency for TTS and PTS.

Figure 3.8-21: TTS and PTS Exposure Functions for Impulsive Sounds

For impulsive sounds, hearing loss in other species has also been observed to be related to the unweighted peak pressure of a received sound. Because this data does not exist for sea turtles, unweighted peak pressure thresholds for TTS and PTS were developed by applying relationships observed between impulsive peak pressure TTS thresholds and auditory sensitivity in marine mammals to sea turtles. This results in dual-metric hearing loss criteria for sea turtles for impulsive sound exposure: the SEL-based exposure functions in Figure 3.8-21 and the peak pressure thresholds in Table 3.8-6. The derivation of the sea turtle impulsive peak pressure TTS and PTS thresholds are provided in the technical report *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (U.S. Department of the Navy, 2017).

Table 3.8-6: TTS and PTS Peak Pressure Thresholds Derived for Sea Turtles Exposed to Impulsive Sounds

Auditory Effect	*Unweighted Peak Pressure Threshold*
TTS	226 dB re 1 μPa SPL peak
PTS	232 dB re 1 μPa SPL peak

Notes: dB re 1 μPa = decibels referenced to 1 micropascal, PTS = permanent threshold shift, SPL = sound pressure level, TTS = temporary threshold shift

Accounting for Mitigation

The Navy implements mitigation measures (described in Chapter 5, Mitigation) during explosive activities, including delaying detonations when a sea turtle or marine mammal is observed in the mitigation zone. The mitigation zones encompass the estimated ranges to mortality for a given explosive. Therefore, the impact analysis quantifies the potential for mitigation to reduce the risk of mortality due to exposure to explosives. Two factors are considered when quantifying the effectiveness of mitigation: (1) the extent to which the type of mitigation proposed for a sound-producing activity (e.g., active sonar) allows for observation of the mitigation zone prior to and during the activity; and (2) the sightability of each species that may be present in the mitigation zone, which is determined by species-specific characteristics and the viewing platform. A detailed explanation of the analysis is provided in the technical report *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2018).

In the quantitative analysis, consideration of mitigation measures means that, for activities where mitigation is feasible, model-estimated mortality is considered mitigated to the level of injury. The impact analysis does not analyze the potential for mitigation to reduce TTS or behavioral effects, even though mitigation could also reduce the likelihood of these effects. In practice, mitigation also protects all unobserved (below the surface) animals in the vicinity, including other species, in addition to the observed animal. However, the analysis assumes that only animals sighted at the water surface would be protected by the applied mitigation. The analysis, therefore, does not capture the protection afforded to all marine species that may be near or within the mitigation zone.

3.8.3.2.2.2 Impact Ranges for Explosives

Ranges to effect (see Table 3.8-7 through Table 3.8-10) were developed in the Navy Acoustic Effects Model based on the thresholds for TTS, PTS, injury, and mortality discussed above.

Table 3.8-7: Ranges to Mortality for Sea Turtles Exposed to Explosives as a Function of Animal Mass[1]

Bin	*Animal Mass Intervals (kg)*[1,2]				
	10	***50***	***100***	***150***	***300***
E1	3 (2–3)	0 (0–2)	0 (0–0)	0 (0–0)	0 (0–0)
E2	4 (3–4)	2 (2–3)	1 (0–2)	1 (0–2)	0 (0–0)
E3	8 (6–10)	5 (4–6)	4 (3–4)	3 (3–4)	2 (2–2)
E4	14 (0–30)	9 (0–19)	7 (0–15)	6 (4–12)	5 (3–8)
E5	13 (11–30)	8 (7–15)	7 (6–12)	6 (5–10)	4 (4–7)
E6	18 (14–50)	12 (9–30)	10 (7–23)	8 (7–19)	6 (5–13)
E7	69 (55–85)	40 (35–45)	30 (25–35)	25 (24–30)	19 (18–21)
E8	47 (0–100)	30 (0–55)	23 (0–40)	20 (0–30)	16 (9–21)
E9	32 (30–55)	23 (22–25)	19 (18–20)	17 (16–18)	13 (12–13)
E10	59 (35–190)	26 (25–40)	24 (21–35)	21 (19–35)	16 (15–25)
E11	213 (180–400)	135 (120–210)	105 (100–170)	92 (85–140)	63 (55–100)
E12	133 (50–320)	46 (30–150)	27 (25–35)	25 (25–30)	20 (19–21)
E16	931 (800–1,025)	676 (600–850)	538 (525–550)	485 (470–500)	376 (370–390)
E17	1,359 (1,025–2,025)	1,077 (900–1,275)	929 (800–1,025)	841 (750–925)	728 (675–850)

[1] Ranges based on the mortality impact threshold (see Criteria and Thresholds Used to Predict Impacts from Explosives) in Section 3.8.3.2.2.1 (Methods for Analyzing Impacts from Explosives).

[2] Average distance (m) to mortality is depicted above the minimum and maximum distances which are in parentheses.

Table 3.8-8: Ranges to Non-Auditory Injury[1] (in meters) for Sea Turtles Exposed to Explosives as a Function of Animal Mass

Bin	Animal Mass Intervals (kg)[1,2]				
	10	50	100	150	300
E1	12 (11–13)	12 (11–13)	12 (11–13)	12 (11–13)	12 (11–13)
E2	15 (15–16)	15 (15–16)	15 (15–16)	15 (15–16)	15 (15–16)
E3	25 (25–40)	25 (25–40)	25 (25–40)	25 (25–40)	25 (25–40)
E4	30 (0–65)	30 (0–55)	30 (0–55)	30 (9–55)	30 (7–55)
E5	41 (30–70)	41 (30–70)	41 (30–70)	41 (30–70)	41 (30–70)
E6	53 (40–130)	53 (40–90)	53 (40–90)	53 (40–90)	53 (40–90)
E7	166 (110–190)	94 (75–110)	92 (75–110)	92 (75–110)	92 (75–110)
E8	107 (0–230)	88 (0–130)	88 (0–130)	88 (19–130)	88 (17–130)
E9	119 (90–300)	119 (90–140)	119 (90–130)	119 (90–130)	119 (90–130)
E10	169 (90–480)	139 (90–270)	139 (90–190)	139 (90–160)	139 (90–160)
E11	436 (310–1,275)	284 (230–525)	223 (190–500)	192 (170–500)	191 (170–500)
E12	300 (140–675)	188 (140–400)	188 (140–320)	188 (140–270)	188 (140–220)
E16	1,460 (1,275–2,025)	1,146 (975–1,775)	962 (825–1,775)	888 (775–1,775)	844 (650–1,775)
E17	2,520 (1,275–4,275)	1,751 (1,275–3,025)	1,442 (1,275–3,025)	1,414 (1,025–3,025)	1,414 (1,025–3,025)

[1] Ranges based on the injury impact threshold (see Criteria and Thresholds Used to Predict Impacts from Explosives) in Section 3.8.3.2.2.1 Methods for Analyzing Impacts from Explosives).

[2] Average distance (m) to non-auditory injury is depicted above the minimum and maximum distances, which are in parentheses. The ranges depicted are the further of the ranges for impulse or peak pressure thresholds for an explosive bin and animal mass interval combination.

Table 3.8-9: Peak Pressure Based Ranges to PTS and TTS for Sea Turtles Exposed to Explosives

Range to Effects for Explosives Bin: Sea Turtles[1]			
Bin	***Source Depth (m)***	***PTS***	***TTS***
E1	0.1	36 (30–60)	66 (50–100)
E2	0.1	44 (40–60)	70 (60–85)
E3	18.25	80 (80–110)	152 (140–230)
E4	15	111 (100–180)	220 (190–440)
	19.8	101 (100–110)	198 (190–250)
	198	85 (65–110)	181 (170–220)
E5	0.1	116 (75–140)	210 (100–250)
E6	0.1	144 (95–170)	257 (130–320)
	30	218 (160–450)	436 (300–1,275)
E7	15	321 (250–410)	660 (500–850)
E8	0.1	243 (130–320)	403 (190–525)
	45.75	334 (280–775)	696 (500–1,775)
	305	250 (210–310)	508 (490–625)
E9	0.1	350 (230–400)	563 (330–750)
E10	0.1	389 (180–925)	619 (320–1,275)
E11	18.5	715 (480–2,025)	1,350 (800–3,775)
	45.75	761 (525–1,775)	1,399 (925–3,525)
E12	0.1	510 (310–675)	797 (460–2,025)
E16	61	2,500 (1,275–5,775)	3,761 (1,275–9,275)
E17	61	3,097 (1,275–8,275)	4,735 (1,525–10,275)

[1]Average distance (m) to PTS and TTS are depicted above the minimum and maximum distances which are in parentheses. Values depict the maximum range produced by the peak pressure metric.

Notes: PTS = permanent threshold shift, TTS = temporary threshold shift

Table 3.8-10: SEL Based Ranges to PTS and TTS for Sea Turtles Exposed to Explosives

Range to Effects for Explosives: Sea Turtles[1]				
Bin	Source Depth (m)	Cluster Size	PTS	TTS
E1	0.1	1	0 (0–0)	0 (0–0)
		20	0 (0–0)	2 (2–4)
E2	0.1	1	0 (0–0)	0 (0–0)
		2	0 (0–0)	0 (0–0)
E3	18.25	1	3 (3–3)	17 (16–19)
		50	25 (23–25)	145 (130–220)
E4	15	1	5 (5–8)	41 (40–50)
		5	13 (12–17)	99 (90–110)
	19.8	2	7 (7–7)	50 (50–50)
	198	2	4 (0–7)	18 (0–35)
E5	0.1	25	6 (6–14)	41 (25–160)
E6	0.1	1	2 (2–3)	11 (10–15)
	30	1	16 (13–24)	129 (95–360)
E7	15	1	51 (45–55)	361 (330–390)
E8	0.1	1	6 (5–11)	60 (25–180)
	45.75	1	40 (40–65)	308 (260–725)
	305	1	15 (0–35)	128 (55–190)
E9	0.1	1	9 (9–20)	160 (40–350)
E10	0.1	1	15 (13–25)	207 (50–625)
E11	18.5	1	229 (170–440)	1,474 (750–4,025)
	45.75	1	179 (170–260)	1,143 (700–2,775)
E12	0.1	1	25 (18–120)	367 (80–900)

Table 3.8-10: SEL Based Ranges to PTS and TTS for Sea Turtles Exposed to Explosives (continued)

Range to Effects for Explosives: Sea Turtles[1]				
Bin	**Source Depth (m)**	**Cluster Size**	**PTS**	**TTS**
E16	61	1	1,059 (900–1,525)	5,257 (1,525–10,525)
E17	61	1	1,869 (1,275–2,775)	13,443 (7,775–23,275)

[1] Average distance (m) to PTS and TTS are depicted above the minimum and maximum distances which are in parentheses. Values depict the maximum range produced by the SEL metric.
Notes: PTS = permanent threshold shift, TTS = temporary threshold shift

Presentation of Estimated Impacts from the Quantitative Analysis

The results of the analysis of potential impacts to sea turtles from explosives as described in Section 3.8.3.2.2.1 (Methods for Analyzing Impacts from Explosives) are discussed below. Estimated numbers of potential impacts from the quantitative analysis for each species of sea turtle from exposure to explosive energy and sound for training and testing activities are presented below. The most likely regions and activity categories from which the impacts could occur are displayed in the figures for each species of sea turtle. Additionally, results of Ship Shock Trial are presented separately in the section for impacts due to testing. There is a potential for impacts to occur anywhere within the Study Area where sound and energy from explosives and the species overlap, although only areas or categories where 0.5 percent of the impact, or greater, are estimated to occur are graphically represented on the species specific figures below. All (i.e., grand total) estimated impacts are included in the graphics, regardless of region or category.

The numbers of activities planned can vary slightly from year-to-year. Results are presented for a maximum explosive use year; however, during most years, explosive use would be less resulting in fewer potential impacts. The number of explosives used are described in Section 3.0.3.3.2 (Explosive Stressors). Impacts to crocodilians and terrapins are discussed qualitatively below as appropriate.

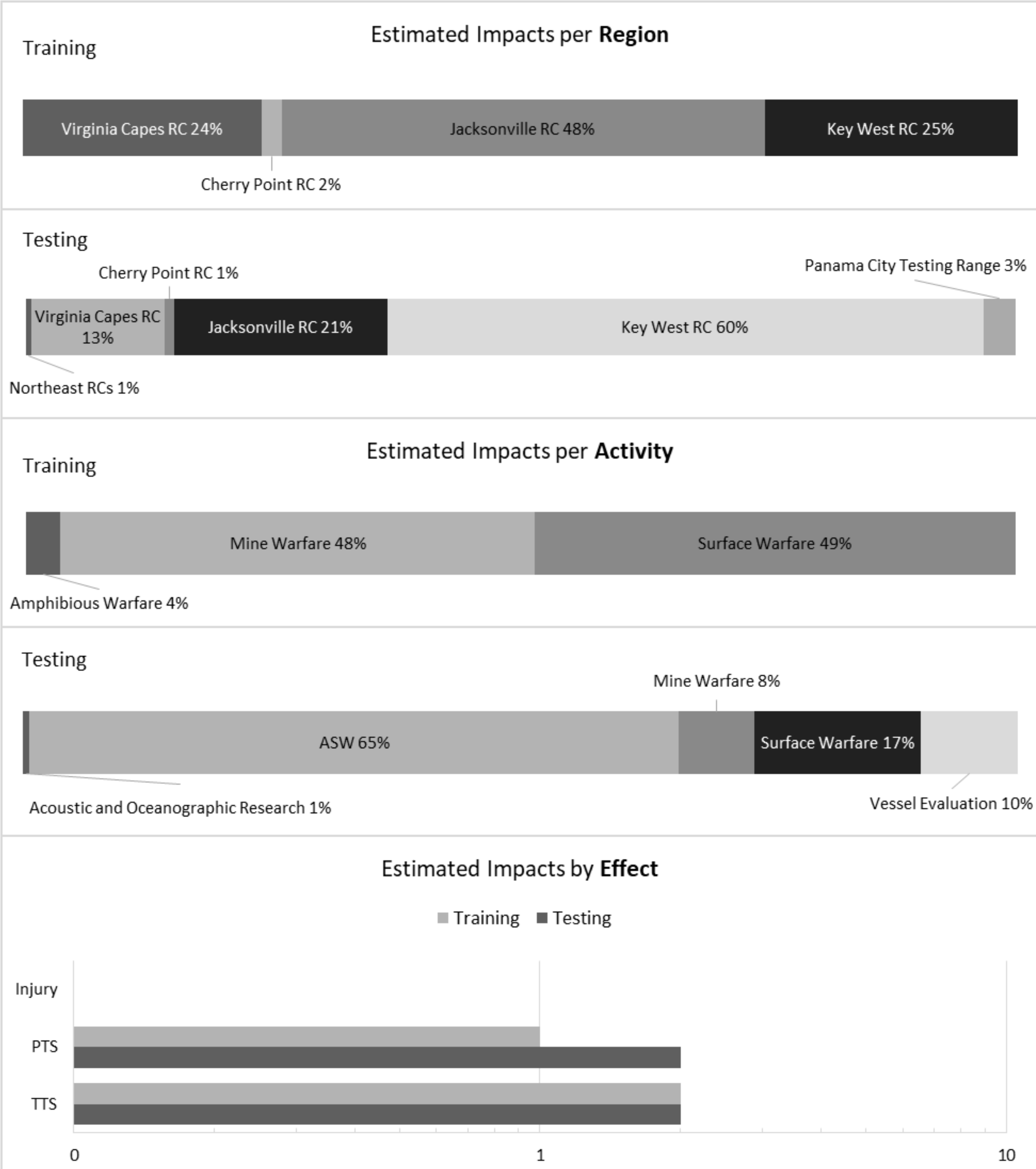
3.8.3.2.2.3 Impacts from Explosives under Alternative 1

Impacts from Explosives under Alternative 1 for Training Activities

Activities using explosives would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). General characteristics, quantities, and net explosive weights of in-water explosives used during training under Alternative 1 are provided in Section 3.0.3.3.2 (Explosive Stressors). Quantities and locations of fragment-producing explosives during training under Alternative 1 are shown in Section 3.0.3.3.4.2 (Military Expended Materials). Under Alternative 1, there could be fluctuation in the amount of explosions that could occur annually, although potential impacts would be similar from year to year.

Training activities involving explosions would typically be conducted in the range complexes, with greater occurrence in the Virginia Capes and Jacksonville Range Complexes. Activities that involve underwater detonations and explosive munitions typically occur more than 3 NM from shore.

The estimated impacts on sea turtles from explosives during training activities presented in Figure 3.8-22 through Figure 3.8-25 are for the maximum anticipated training year under Alternative 1 (for impact tables, see Appendix E, Acoustic Impact Tables). Under Alternative 1, it is possible that impacts would be slightly reduced in some years, as explosive use would fluctuate.



Notes: Region and Activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injuries (non-auditory) are estimated for this species. ASW: Anti-Submarine Warfare; RC: Range Complex.

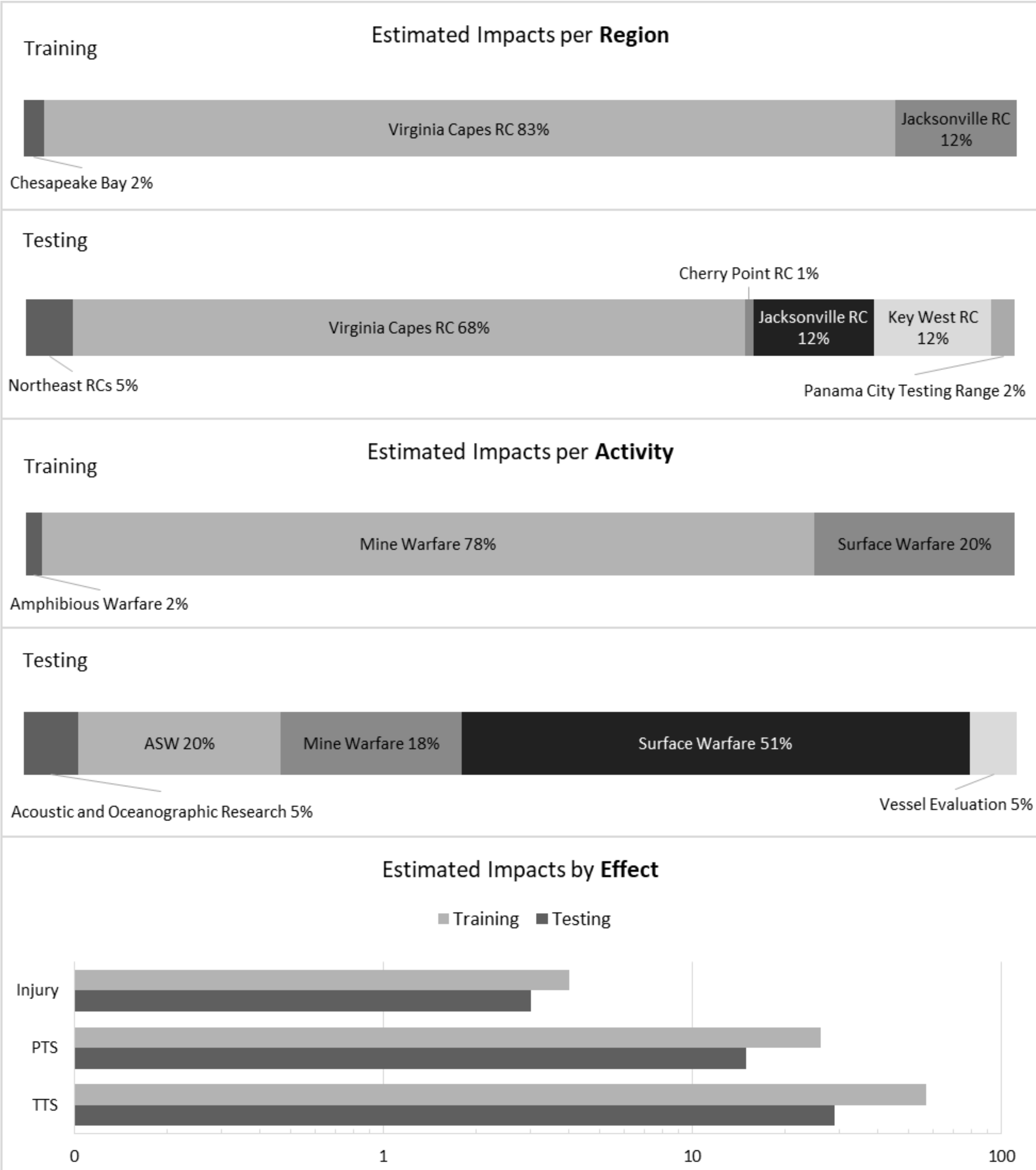
Figure 3.8-22: Green Turtle Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing under Alternative 1 (Excluding Full Ship Shock Trials)

Notes: Region and Activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injuries (non-auditory) are estimated for this species. ASW: Anti-Submarine Warfare; RC: Range Complex.

Figure 3.8-23: Kemp's Ridley Turtle Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing under Alternative 1 (Excluding Full Ship Shock Trials)

Notes: Region and Activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injuries (non-auditory) are estimated for this species. ASW: Anti-Submarine Warfare; RC: Range Complex.

Figure 3.8-24: Leatherback Turtle Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing under Alternative 1 (Excluding Full Ship Shock Trials)



Notes: Region and Activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. ASW: Anti-Submarine Warfare; RC: Range Complex.

Figure 3.8-25: Loggerhead Turtle Impacts Estimated per Year from the Maximum Number of Explosions during Training and Testing under Alternative 1 (Excluding Full Ship Shock Trials)

As shown in the above estimates, the quantitative analysis estimates that a small number of green, Kemp's ridley, leatherback, and loggerhead turtles would be exposed to levels of explosive sound and energy that could cause TTS and PTS, some loggerhead turtles would be injured, and no sea turtles would be killed. The quantitative analysis predicts that no hawksbill sea turtles are likely to be exposed to the levels of explosive sound and energy that could cause TTS, PTS, or injury during training activities under Alternative 1. Fractional estimated impacts per region and activity area represent the probability that the number of estimated impacts by effect will occur in a certain region or be due to a certain activity category.

Threshold shifts and injuries could reduce the fitness of an individual animal, causing a reduction in foraging success, reproduction or increased susceptibility to predators. This reduction in fitness would be temporary for recoverable impacts, such as TTS. There could be long-term consequences to some individuals. However, no population-level impact is expected due to the low number of estimated injuries for any sea turtle species relative to total population size.

As discussed in Section 5.3.3 (Explosive Stressors), procedural mitigation includes ceasing explosive detonations (e.g., ceasing deployment of an explosive bomb) if a sea turtle is observed in the mitigation zone whenever and wherever applicable activities occur. In addition to procedural mitigation, the Navy will implement mitigation within mitigation areas to: (1) avoid or reduce potential impacts from explosives on sea turtles in nearshore waters of the Navy Cherry Point Range Complex during nesting season (see Section 5.4.3, Mitigation Areas off the Mid-Atlantic and Southeastern United States), and (2) avoid or reduce potential impacts on seafloor resources throughout the Study Area (see Section 5.4.1, Mitigation Areas for Seafloor Resources). Mitigation for seafloor resources will help the Navy further avoid or reduce the potential for impacts on sea turtles that shelter and feed on shallow-water coral reefs, live hard-bottom, artificial reefs, submerged aquatic vegetation, and shipwrecks.

Reptile hearing is less sensitive than other marine animals (i.e., marine mammals), and the role of their underwater hearing is unclear. Reptiles' limited hearing range (<2 kHz) is most likely used to detect nearby broadband, continuous environmental sounds, such as the sounds of waves crashing on the beach that may be important for identifying their habitat. Recovery from a hearing threshold shift begins almost immediately after the noise exposure ceases. A temporary threshold shift is expected to take a few minutes to a few days, depending on the severity of the initial shift, to fully recover (U.S. Department of the Navy, 2017). If any hearing loss remains after recovery, that remaining hearing threshold shift is permanent. Because explosions produce broadband sounds with low-frequency content, hearing loss due to explosive sound could occur across a sea turtle's very limited hearing range, reducing the distance over which relevant sounds, such as beach sounds, may be detected for the duration of the threshold shift.

Some reptiles may behaviorally respond to the sound of an explosive. A reptile's behavioral response to a single detonation or explosive cluster is expected to be limited to a short-term startle response, as the duration of noise from these events is very brief. Limited research and observations from air gun studies (see Section 3.8.3.2.2.1, Methods for Analyzing Impacts from Explosives) suggest that if sea turtles are exposed to repetitive impulsive sounds in close proximity, they may react by increasing swim speed, avoiding the source, or changing their position in the water column. There is no evidence to suggest that any behavioral response would persist beyond the sound exposure. Because the duration of most explosive events is brief, the potential for masking is low. In fact, the *ANSI Sound Exposure Guidelines* (Popper et al., 2014) consider masking to not be a concern for sea turtles exposed to explosions. This can also be assumed for crocodilians and terrapins.

A physiological stress response is assumed to accompany any injury, hearing loss, or behavioral reaction. A stress response is a suite of physiological changes that are meant to help an organism mitigate the impact of a stressor. While the stress response is a normal function for an animal dealing with natural stressors in their environment, chronic stress responses could reduce an individual's fitness. Due to the low number of estimated impacts, it is not likely that any reptile would experience repeated stress explosive impacts.

Considering the above factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for sea turtle populations would not be expected.

The use of explosives during training activities would not overlap with green, hawksbill, or leatherback turtle critical habitat around Culebra, Puerto Rico; Mona Island, Puerto Rico; and St. Croix Island, U.S. Virgin Islands respectively. Explosives during training activities would have a pathway to impact the physical and biological features of the constricted migratory habitat and *Sargassum* habitat in the mid-Atlantic and southeast regions by producing "noise pollution" from military activity (79 *Federal Register* 39855). The impacts on these habitats would be considered insignificant with no discernible impact on the conservation function of the physical and biological features as activity would not prevent a turtle from migrating, as explosions are brief in nature.

In addition to sea turtles, crocodilians and terrapins may overlap with explosions occurring in inshore areas. The only training activities involving explosions that would occur in ESA-listed American crocodile habitat involve the underwater detonation of small (2-lb.) charges in enclosed areas of Truman Harbor and Demolition Key in the Key West Range Complex. Alligators and terrapins may also be present in Truman Harbor and Demolition Key, and terrapins may be present in areas with detonations occurring in the inshore waters of the lower Chesapeake Bay. Impacts, if any, to crocodilians and terrapins would be low due to the low probability of occurrence and nature of the confined and restricted detonation locations. The use of explosives would not overlap with American crocodile critical habitat in Florida Bay, which encompasses creeks, canals, and swamps.

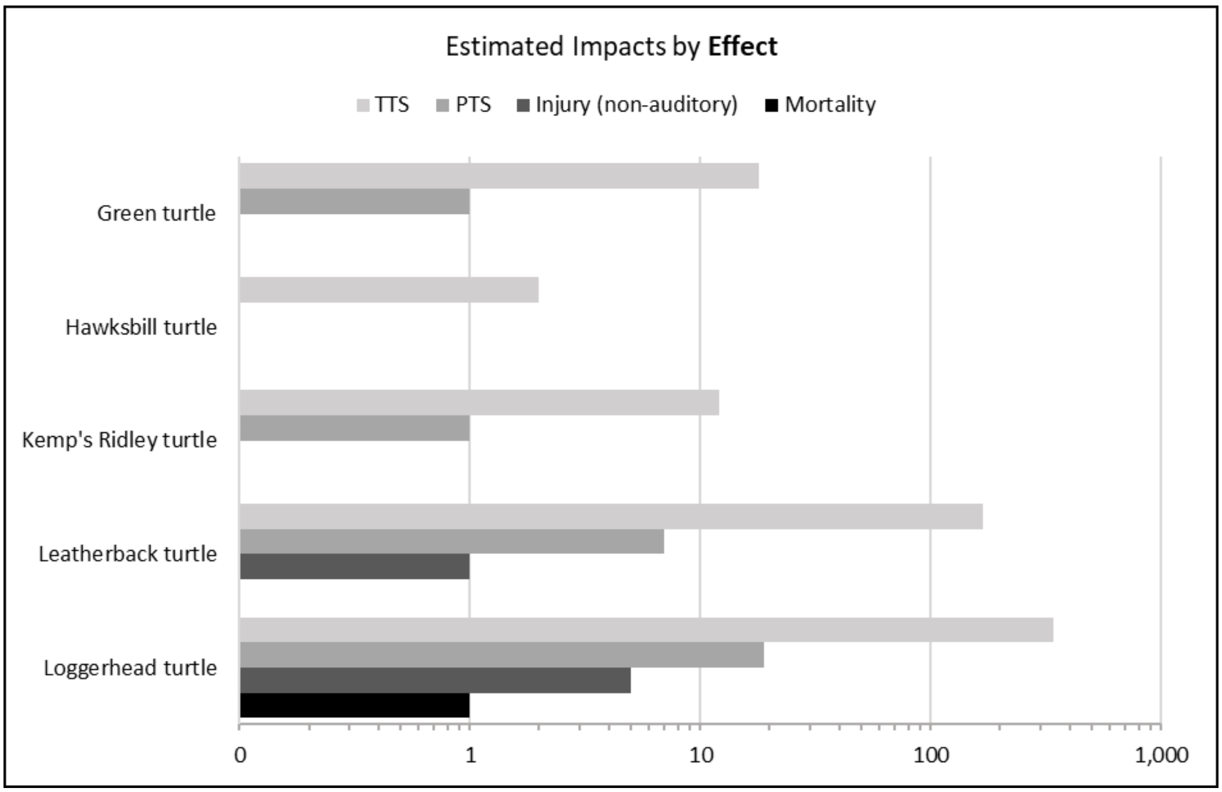
Pursuant to the ESA, the use of explosives during training activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead turtles and the ESA-listed American crocodile. There would be no effect on green, hawksbill, or leatherback turtle or American crocodile critical habitat. The use of explosives during training activities may affect loggerhead constricted migratory and *Sargassum* habitats in the mid-Atlantic and southeast regions. The Navy has consulted with NMFS and USFWS as required by section 7(a)(2) of the ESA.

Impacts from Explosives under Alternative 1 for Testing Activities

Activities using explosives would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). General characteristics, quantities, and net explosive weights of in-water explosives used during testing under Alternative 1 are provided in Section 3.0.3.3.2 (Explosive Stressors). Quantities and locations of fragment-producing explosives during testing under Alternative 1 are shown in 3.0.3.3.4.2 (Military Expended Materials).

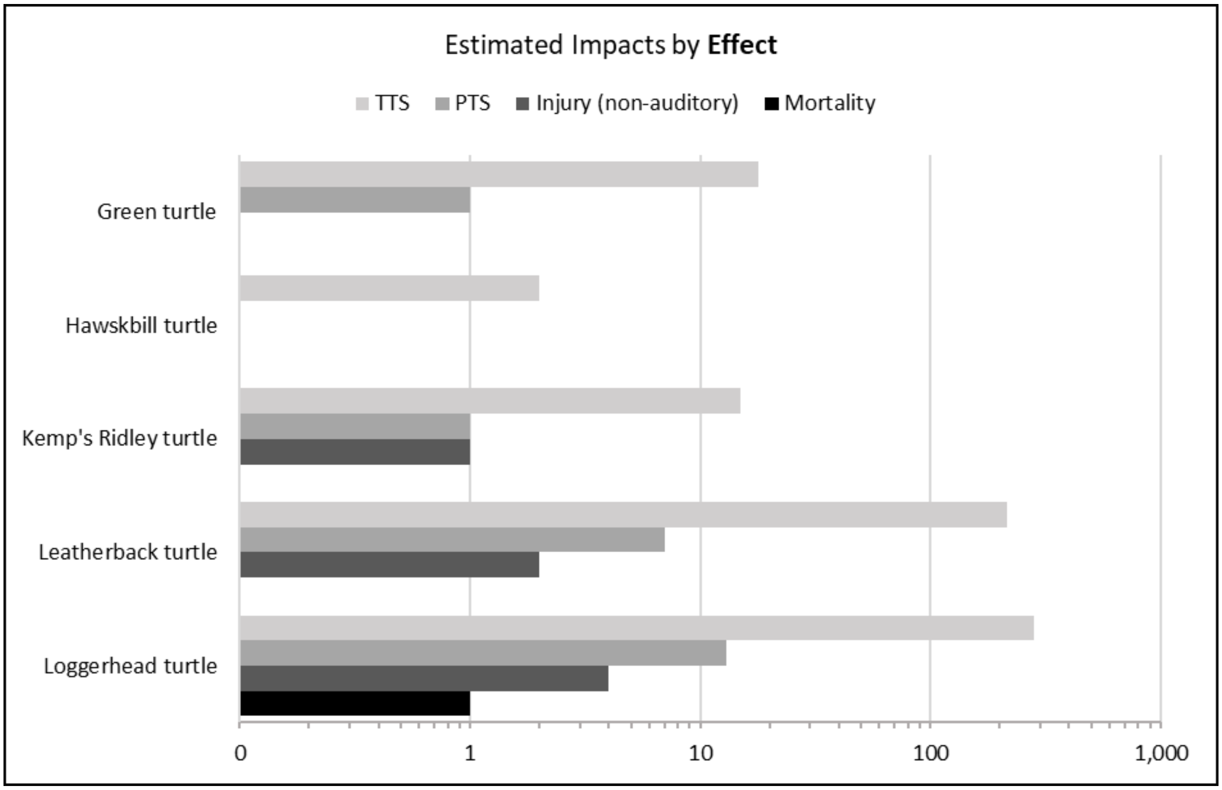
Under Alternative 1, the number of testing activities using explosives could fluctuate annually. Testing activities involving explosions would typically be conducted on range complexes and on testing ranges, and do not occur in inshore waters. Activities that involve underwater detonations and explosive munitions typically occur more than 3 NM from shore. Very few activities would be conducted in the Naval Undersea Warfare Center Division, Newport Testing Range, and the Naval Surface Warfare Center Carderock Division, South Florida Ocean Measurement Facility Testing Range.

The estimated impacts on sea turtles from explosives during testing activities presented in Figure 3.8-22 through Figure 3.8-25 are for the maximum anticipated testing year under Alternative 1, excluding ship shock trials (for impact tables, see Appendix E, Acoustic Impact Tables). The estimated impacts on sea turtles from a small ship shock trial and a large ship shock trial are shown in Figure 3.8-26 and Figure 3.8-27. The results shown include the impacts due to all four separate detonations that constitute a single full ship shock trial. Small Ship Shock Trials could take place any season within the deep offshore water of the Virginia Capes Range Complex or in the spring, summer, or fall within the Jacksonville Range Complex and would occur up to three times over a 5-year period. The Large Ship Shock Trial could take place in the Jacksonville Range Complex during the spring, summer, or fall and during any season within the deep offshore water of the Virginia Capes or Gulf of Mexico Range Complexes. The Large Ship Shock Trial would occur once over five years. In addition, no ship shock trials would be conducted in the Jacksonville Range Complex between November and April due to North Atlantic right whale calving season. The estimated impacts shown are the worst case for each species in any season at any of the possible ship shock trial locations; therefore, they over-estimate the actual potential for impacts.



Note: As shown in the estimates above, the quantitative analysis estimates that one loggerhead turtle could be killed and a small number of loggerhead and leatherback turtles could be injured.

Figure 3.8-26: Estimated Impacts on Sea Turtles from a Small Ship Shock Trial under Alternative 1



Note: As shown in the estimates above, the quantitative analysis estimates that one loggerhead turtle could be killed and a small number of most other sea turtle species could be injured.

Figure 3.8-27: Estimated Impacts on Sea Turtles from a Large Ship Shock Trial under Alternative 1

As shown in the above estimates, the quantitative analysis estimates that a small number of green, Kemp's ridley, loggerhead, and leatherback turtles would be exposed to levels of explosive sound and energy that could cause TTS and PTS, some loggerhead sea turtles would be injured, and no sea turtles would be killed, excluding ship shock trials. The quantitative analysis predicts that no hawksbill sea turtles are likely to be exposed to the levels of explosive sound and energy that could cause TTS, PTS, or injury during testing activities under Alternative 1, excluding ship shock trials. In Figure 3.8-22 to Figure 3.8-25, fractional estimated impacts per region and activity area represent the probability that the number of estimated impacts by effect will occur in a certain region or be due to a certain activity category. Additionally, the quantitative analysis estimates that one loggerhead turtle could be killed during a small ship shock trial and one during a large ship shock trial (Figure 3.8-26 and Figure 3.8-27). All sea turtle species present in the Study Area could be exposed to levels of explosive sound and energy that could cause TTS or PTS, and only Kemp's, leatherback, or loggerhead turtles could be injured during small or large ship shock trials.

Threshold shifts and injuries could affect the fitness of an individual animal, causing a reduction in foraging success, reproduction, or increased susceptibility to predators. This reduction in fitness would be temporary for recoverable impacts, such as TTS, but there could be long-term consequences to some individuals. However, no population-level impact would occur due to the low number of estimated injuries for any sea turtle species relative to total population size.

As discussed in Section 5.3.3 (Explosive Stressors), procedural mitigation includes ceasing explosive detonations (e.g., ceasing deployment of an explosive bomb) if a sea turtle is observed in the mitigation zone whenever and wherever applicable activities occur. Navy also implements additional procedural mitigation during sea turtle nesting season in the Naval Surface Warfare Center, Panama City Division Testing Range during line charge testing events. In addition to procedural mitigation, the Navy will implement mitigation within mitigation areas to: (1) avoid or reduce potential impacts from explosives on sea turtles in nearshore waters of the Navy Cherry Point Range Complex during nesting season (see Section 5.4.3, Mitigation Areas off the Mid-Atlantic and Southeastern United States), and (2) avoid or reduce potential impacts on seafloor resources throughout the Study Area (see Section 5.4.1, Mitigation Areas for Seafloor Resources). Mitigation for seafloor resources will help the Navy further avoid or reduce the potential for impacts on sea turtles that shelter and feed on shallow-water coral reefs, live hard-bottom, artificial reefs, submerged aquatic vegetation, and shipwrecks.

The Navy also develops detailed ship shock mitigation plans prior to conducting ship shock trials. Ship shock trial procedural mitigations include pre-activity observation for sea turtles and floating vegetation that may indicate the possible presence of sea turtles in a large mitigation zone around the ship shock trial location, with delay or re-location if the site is deemed environmentally unsuitable, as described in Section 5.3.3.11 (Ship Shock Trials). These mitigations would reduce the potential for some exposures to high levels of explosive sound and energy.

Reptile hearing is less sensitive than other marine animals (i.e., marine mammals), and the role of their underwater hearing is unclear. Reptiles' limited hearing range (<2 kHz) is most likely used to detect nearby broadband, continuous environmental sounds, such as the sounds of waves crashing on the beach that may be important for identifying their habitat. Recovery from a hearing threshold shift begins almost immediately after the noise exposure ceases. A temporary threshold shift is expected to take a few minutes to a few days, depending on the severity of the initial shift, to fully recover. If any hearing loss remains after recovery, that remaining hearing threshold shift is permanent. Because explosions produce broadband sounds with low-frequency content, hearing loss due to explosives could occur across a sea turtle's very limited hearing range, reducing the distance over which relevant sounds, such as beach sounds, may be detected for the duration of the threshold shift.

Some reptiles may behaviorally respond to the sound of an explosive. A reptile's behavioral response to a single detonation or explosive cluster is expected to be limited to a short-term (seconds to minutes) startle response, as the duration of noise from these events is very brief. Limited research and observations from air gun studies (Section 3.8.3.2.2.1, Methods for Analyzing Impacts from Explosives) suggest that if sea turtles are exposed to repetitive impulsive sounds in close proximity, they may react by increasing swim speed, avoiding the source, or changing their position in the water column. There is no evidence to suggest that any behavioral response would persist beyond the sound exposure.

A physiological stress response is assumed to accompany any injury, hearing loss, or behavioral reaction. A stress response is a suite of physiological changes that are meant to help an organism mitigate the impact of a stressor. While the stress response is a normal function for an animal dealing with natural stressors in their environment, chronic stress responses could reduce an individual's fitness. Due to the low number of estimated impacts, there is a low likelihood that a reptile would experience repeated stress responses due to explosive impacts. Because the duration of most explosive events is brief, the potential for masking is low. The *ANSI Sound Exposure Guidelines* (Popper et al., 2014) consider masking to not be a concern for sea turtles exposed to explosions.

Considering the above factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for sea turtle populations would not be expected.

The use of explosives during testing activities would not overlap with green, hawksbill, or leatherback turtle critical habitat around Culebra, Puerto Rico; Mona Island, Puerto Rico; and St. Croix Island, U.S. Virgin Islands respectively. Explosives during training activities would have a pathway to impact the physical and biological features of the constricted migratory habitat and *Sargassum* habitat in the mid-Atlantic and southeast regions by producing "noise pollution" from military activity (79 *Federal Register* 39855). The impacts on these habitats would be considered insignificant with no discernible impact on the conservation function of the physical and biological features as activity would not prevent a turtle from migrating, as explosions are brief in nature.

Explosives would not be used in crocodilian, including the ESA-listed American crocodile, or terrapin habitats during testing activities. Additionally, the use of explosives would not overlap with American crocodile critical habitat in Florida Bay, which encompasses creeks, canals, and swamps.

Pursuant to the ESA, the use of explosives during testing activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead turtles; and would have no effect on the ESA-listed American crocodile. There would be no effect on green, hawksbill, or leatherback turtle critical habitat or on American crocodile critical habitat. The use of explosives during testing activities may affect loggerhead constricted migratory and *Sargassum* habitats in the mid-Atlantic and southeast regions. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA.

3.8.3.2.2.4 Impacts from Explosives under Alternative 2

Impacts from Explosives under Alternative 2 for Training Activities

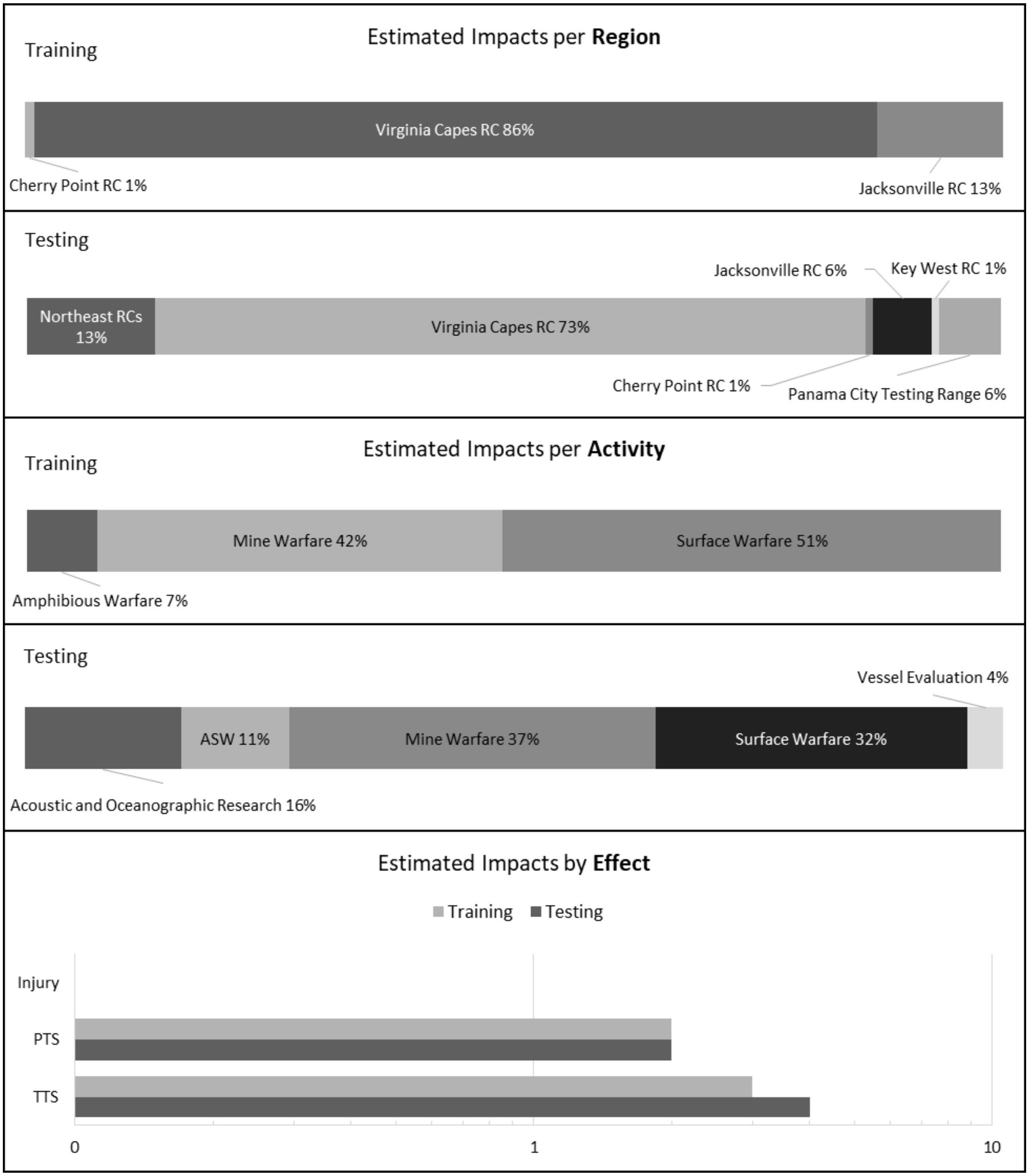
Under Alternative 2, the maximum number of training activities could occur every year. Activities using explosives would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). General characteristics, quantities, and net explosive weights of in-water explosives used during training under Alternative 2 are provided in Section 3.0.3.3.2 (Explosive Stressors). Quantities and locations of fragment-producing explosives during training under Alternative 2 are shown in 3.0.3.3.4.2 (Military Expended Materials).

Training activities involving explosions would typically be conducted in the range complexes, with greater occurrence in the Virginia Capes and Jacksonville Range complexes. Activities that involve underwater detonations and explosive munitions typically occur more than 3 NM from shore.

The estimated impacts on sea turtles from explosions during a maximum year of training under Alternative 2 are presented in Figure 3.8-28 to Figure 3.8-31. Estimated impacts for Alternative 2 are identical to those described in Section 3.8.3.2.2.3 (Impacts from Explosives Under Alternative 1).

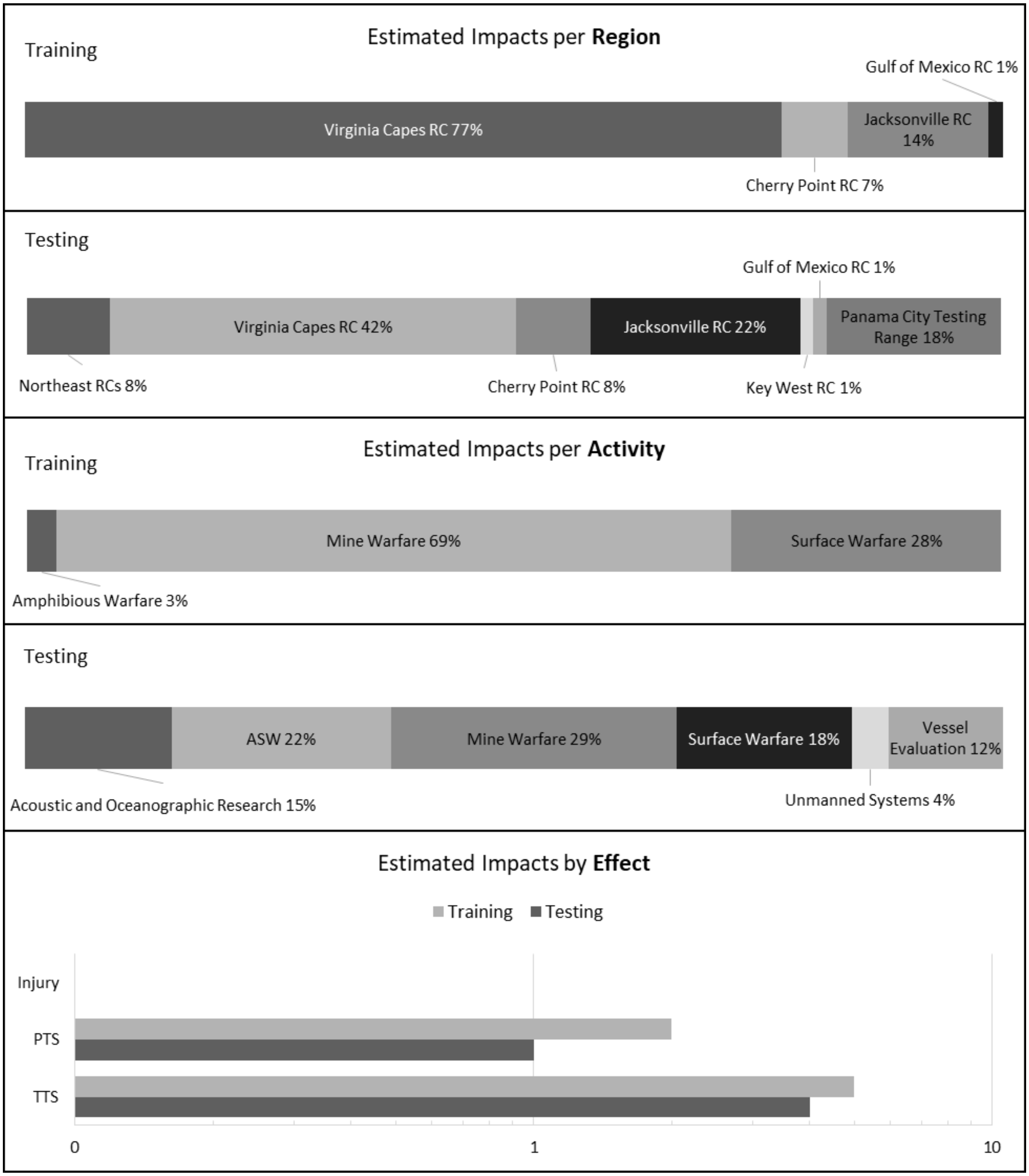
Notes: Region and Activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injuries (non-auditory) are estimated for this species. ASW: Anti-Submarine Warfare; RC: Range Complex.

Figure 3.8-28: Green Turtle Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing under Alternative 2 (Excluding Full Ship Shock Trials)



Notes: Region and Activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injuries (non-auditory) are estimated for this species. ASW: Anti-Submarine Warfare; RC: Range Complex.

Figure 3.8-29: Kemp's Ridley Turtle Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing under Alternative 2 (Excluding Full Ship Shock Trials)



Notes: Region and Activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. No injuries (non-auditory) are estimated for this species. ASW: Anti-Submarine Warfare; RC: Range Complex.

Figure 3.8-30: Leatherback Sea Turtle Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing under Alternative 2 (Excluding Full Ship Shock Trials)

Notes: Region and Activity bar charts show categories +/- 0.5 percent of the estimated impacts. Estimated impacts most years would be less based on fewer explosions. ASW: Anti-Submarine Warfare; RC: Range Complex.

Figure 3.8-31: Loggerhead Sea Turtle Impacts Estimated per Year from the Maximum Number of Explosions During Training and Testing under Alternative 2 (Excluding Full Ship Shock Trials)

As shown in the above estimates, the quantitative analysis estimates that a small number of green, Kemp's ridley, leatherback, and loggerhead turtles would be exposed to levels of explosive sound and energy that could cause TTS and PTS, some loggerhead turtles would be injured, and no sea turtles would be killed. The quantitative analysis predicts that no hawksbill sea turtles are likely to be exposed to the levels of explosive sound and energy that could cause TTS, PTS, or injury during training activities under Alternative 2. Fractional estimated impacts per region and activity area represent the probability that the number of estimated impacts by effect will occur in a certain region or be due to a certain activity category.

Threshold shifts and injuries could reduce the fitness of an individual animal, causing a reduction in foraging success, reproduction, or increased susceptibility to predators. This reduction in fitness would be temporary for recoverable impacts, such as TTS, but there could be long-term consequences to some individuals. However, no population-level impact is expected due to the low number of estimated injuries for any sea turtle species relative to total population size.

As discussed in Section 5.3.3 (Explosive Stressors), procedural mitigation includes ceasing explosive detonations (e.g., ceasing deployment of an explosive bomb) if a sea turtle is observed in the mitigation zone whenever and wherever applicable activities occur. In addition to procedural mitigation, the Navy will implement mitigation within mitigation areas to: (1) avoid or reduce potential impacts from explosives on sea turtles in nearshore waters of the Navy Cherry Point Range Complex during nesting season (see Section 5.4.3, Mitigation Areas off the Mid-Atlantic and Southeastern United States), and (2) avoid or reduce potential impacts on seafloor resources throughout the Study Area (see Section 5.4.1, Mitigation Areas for Seafloor Resources). Mitigation for seafloor resources will help the Navy further avoid or reduce the potential for impacts on sea turtles that shelter and feed on shallow-water coral reefs, live hard-bottom, artificial reefs, submerged aquatic vegetation, and shipwrecks.

Considering the above factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for sea turtle population would not be expected.

The use of explosives during training activities would not overlap with green, hawksbill, or leatherback turtle critical habitat around Culebra, Puerto Rico; Mona Island, Puerto Rico; and St. Croix Island, U.S. Virgin Islands respectively. Explosives during training activities would have a pathway to impact the physical and biological features of the constricted migratory habitat and *Sargassum* habitat in the mid-Atlantic and southeast regions by producing "noise pollution" from military activity (79 *Federal Register* 39855). The impacts on these habitats would be considered insignificant with no discernible impact on the conservation function of the physical and biological features as activity would not prevent a turtle from migrating, as explosions are brief in nature.

In addition to sea turtles, crocodilians and terrapins may overlap with explosions occurring in inshore areas. The only training activities involving explosions that would occur in ESA-listed American crocodile habitat involves the underwater detonation of small (2-lb.) charges in enclosed areas of Truman Harbor and Demolition Key in the Key West Range Complex. Alligators and terrapins may also be present in Truman Harbor and Demolition Key, and terrapins may be present in areas with detonations occurring in the inshore waters of the lower Chesapeake Bay. Impacts, if any, to crocodilians and terrapins would be low due to the low probability of occurrence and nature of the confined and restricted detonation locations. The use of explosives would not overlap with American crocodile critical habitat in Florida Bay, which encompasses creeks, canals, and swamps.

Pursuant to the ESA, the use of explosives during training activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and may affect the ESA-listed American crocodile. There would be no effect on green, hawksbill, or leatherback sea turtle critical habitat or on American crocodile critical habitat. The use of explosives during training activities may affect loggerhead constricted migratory and *Sargassum* habitats in the mid-Atlantic and southeast regions.

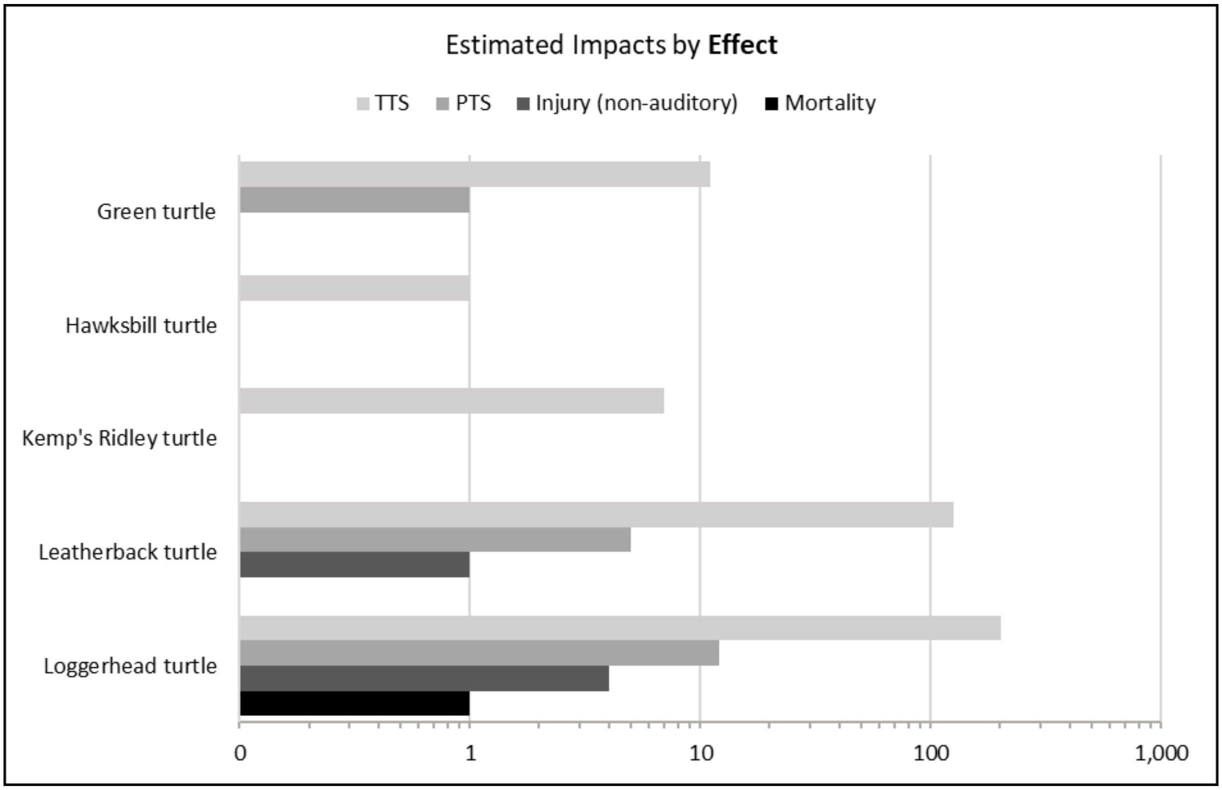
Impacts from Explosives under Alternative 2 for Testing Activities

Under Alternative 2, the maximum number of testing activities could occur every year. Activities using explosives would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). General characteristics, quantities, and net explosive weights of in-water explosives used during testing under Alternative 2 are provided in Section 3.0.3.3.2 (Explosive Stressors). Quantities and locations of fragment-producing explosives during testing under Alternative 2 are shown in 3.0.3.3.4.2 (Military Expended Materials).

Testing activities involving explosions would typically be conducted on range complexes and on testing ranges, and do not occur in inshore waters. Activities that involve underwater detonations and explosive munitions typically occur more than 3 NM from shore.

Annual use of explosives during testing under Alternative 2 is nearly identical to the maximum year of testing under Alternative 1. Therefore, estimated impacts under Alternative 2 are nearly identical to those described in Section 3.8.3.2.2.3 (Impacts from Explosives under Alternative 1).

The estimated impacts on sea turtles from explosives during testing activities presented in Figure 3.8-28 through Figure 3.8-31 are for the maximum anticipated testing year under Alternative 2, excluding ship shock trials (for impact tables, see Appendix E, Acoustic Impact Tables). The estimated impacts on sea turtles from a small ship shock trial are shown in Figure 3.8-32. No impacts were estimated for a large ship shock trial. Small ship shock trials could take place any season within the deep offshore water of the Virginia Capes Range Complex or in the spring, summer, or fall within the Jacksonville Range Complex and would occur up to three times over a five-year period. In addition, no ship shock trials would be conducted in the Jacksonville Range Complex between November and April due to North Atlantic right whale calving season. The estimated impacts shown are the worst case for each species in any season at any of the possible ship shock trial locations; therefore, they over-estimate the actual potential for impacts.



Note: As shown in the estimates above, the quantitative analysis estimates that one loggerhead turtle could be killed and a small number of loggerhead and leatherback turtle species could be injured.

Figure 3.8-32: Estimated Impacts on Sea Turtles from a Small Ship Shock Trial

As shown in Figure 3.8-28 through Figure 3.8-31, the quantitative analysis estimates that a small number of green, Kemp's ridley, leatherback, and loggerhead turtles would be exposed to levels of explosive sound and energy that could cause TTS and PTS, some loggerhead sea turtles would be injured, and no sea turtles would be killed, excluding ship shock trials. The quantitative analysis predicts that no hawksbill sea turtles are likely to be exposed to the levels of explosive sound and energy that could cause TTS, PTS, or injury during testing activities under Alternative 2, excluding ship shock trials. In Figure 3.8-28 to Figure 3.8-31, fractional estimated impacts per region and activity area represent the probability that the number of estimated impacts by effect will occur in a certain region or be due to a certain activity category. During a small ship shock trial, the quantitative analysis estimates that one loggerhead turtle could be killed (Figure 3.8-32). All sea turtle species present in the Study Area could be exposed to levels of explosive sound and energy that could cause TTS or PTS, and only leatherback or loggerhead turtles could be injured during a small ship shock trial.

Threshold shifts and injuries could affect the fitness of an individual animal, causing a reduction in foraging success, reproduction, or increased susceptibility to predators. This reduction in fitness would be temporary for recoverable impacts, such as TTS, but there could be long-term consequences to some individuals. However, no population-level impact would occur due to the low number of estimated injuries for any sea turtle species relative to total population size.

As discussed in Section 5.3.3 (Explosive Stressors), procedural mitigation includes ceasing explosive detonations (e.g., ceasing deployment of an explosive bomb, ceasing explosive missile firing) if a sea turtle is observed in the mitigation zone whenever and wherever applicable activities occur. Navy also implements additional procedural mitigation during sea turtle nesting season in the Naval Surface Warfare Center, Panama City Division Testing Range during line charge testing events. In addition to procedural mitigation, the Navy will implement mitigation within mitigation areas to: (1) avoid or reduce potential impacts from explosives on sea turtles in nearshore waters of the Navy Cherry Point Range Complex during nesting season (see Section 5.4.3, Mitigation Areas off the Mid-Atlantic and Southeastern United States), and (2) avoid or reduce potential impacts on seafloor resources throughout the Study Area (see Section 5.4.1, Mitigation Areas for Seafloor Resources). Mitigation for seafloor resources will help the Navy further avoid or reduce the potential for impacts on sea turtles that shelter and feed on shallow-water coral reefs, live hard-bottom, artificial reefs, submerged aquatic vegetation, and shipwrecks.

The Navy also develops detailed ship shock mitigation plans prior to conducting ship shock trials. Ship shock trial procedural mitigations include pre-activity observation for sea turtles and floating vegetation that may indicate the possible presence of sea turtles in a large mitigation zone around the ship shock trial location, with delay or re-location if the site is deemed environmentally unsuitable, as described in Section 5.3 (Procedural Mitigation to be Implemented). These mitigations would reduce the potential for some exposures to high levels of explosive sound and energy.

Considering the above factors and the mitigation measures that would be implemented as described in Chapter 5 (Mitigation), long-term consequences for sea turtle populations would not be expected.

The use of explosives during testing activities would not overlap with green, hawksbill, or leatherback turtle critical habitat around Culebra, Puerto Rico; Mona Island, Puerto Rico; and St. Croix Island, U.S. Virgin Islands respectively. Explosives during training activities would have a pathway to impact the physical and biological features of the constricted migratory habitat and *Sargassum* habitat in the mid-Atlantic and southeast regions by producing “noise pollution” from military activity (79 *Federal Register* 39855). The impacts on these habitats would be considered insignificant with no discernible impact on the conservation function of the physical and biological features as activity would not prevent a turtle from migrating, as explosions are brief in nature.

Explosives would not be used in crocodilian, including the ESA-listed American crocodile, or terrapin habitats during testing activities. The use of explosives would not overlap with American crocodile critical habitat in Florida Bay, which encompasses creeks, canals, and swamps.

Pursuant to the ESA, the use of explosives during testing activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp’s ridley, loggerhead, and leatherback turtles; and would have no effect on the ESA-listed American crocodile. There would be no effect on green, hawksbill, or leatherback turtle critical habitat or American crocodile critical habitat. The use of explosives during testing activities may affect loggerhead constricted migratory and *Sargassum* habitats in the mid-Atlantic and southeast regions.

3.8.3.2.2.5 Impacts from Explosives under the No Action Alternative

Under the No-Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various explosive stressors would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.8.3.3 Energy Stressors

This section analyzes the potential impacts of energy stressors used during training and testing activities within the Study Area. This section includes analysis of the potential impacts of: (1) in-water electromagnetic devices and (2) high-energy lasers. The potential for impact from electromagnetic energy created by kinetic energy weapons was determined to be low and contained on the surface vessel (Section 3.0.3.3.3.1, In-Water Electromagnetic Devices) and, therefore, will not be analyzed in this section. General discussion of impacts can also be found in Section 3.0.3.6.2 (Conceptual Framework for Assessing Effects from Energy-Producing Activities). Because energy stressors would not occur in habitats used by the American crocodile, the impacts that may potentially occur from energy stressors are limited to sea turtles, American alligators, and as diamondback terrapins.

3.8.3.3.1 Impacts from In-Water Electromagnetic Devices

For a discussion of the types of activities that create an electromagnetic field underwater, refer to Appendix B (Activity Stressor Matrices), and for information on locations and the number of activities proposed for each alternative, see Section 3.0.3.3.3.1 (In-Water Electromagnetic Devices). The devices producing an electromagnetic field are towed or unmanned mine countermeasure systems. The electromagnetic field is produced to simulate a vessel's magnetic field. In an actual mine-clearing operation, the intent is that the electromagnetic field would trigger an enemy mine designed to sense a vessel's magnetic field.

Well over a century ago, electromagnetic fields were introduced into the marine environment within the Study Area from a wide variety of sources (e.g., power transmission cables), yet little is known about the potential impacts on marine life. There is consensus, however, that magnetic fields and other cues (e.g., visual cues), are important for sea turtle orientation and navigation (Lohmann et al., 1997; Putman et al., 2015b). Studies on behavioral responses to magnetic fields have been conducted on green and loggerhead sea turtles. Loggerheads were found to be sensitive to field intensities ranging from 0.005 to 4,000 microteslas, and green sea turtles were found to be sensitive to field intensities from 29.3 to 200 microteslas (Bureau of Ocean Energy Management, 2011). Because these data are the best available information, this analysis assumes that the responses would be similar for other sea turtle species. Sea turtles use geomagnetic fields to navigate at sea, and therefore changes in those fields could impact their movement patterns (Lohmann & Lohmann, 1996; Lohmann et al., 1997). Turtles in all life stages orient to the earth's magnetic field to position themselves in oceanic currents, and directional swimming presumably aided by magnetic orientation has been shown to occur in some sea turtles(Christiansen et al., 2016; Putman & Mansfield, 2015). This helps them locate seasonal feeding and breeding grounds and return to their nesting sites (Lohmann & Lohmann, 1996; Lohmann et al., 1997). Experiments show that sea turtles can detect changes in magnetic fields, which may cause them to deviate from their original direction (Lohmann & Lohmann, 1996; Lohmann et al., 1997). For example, Teuten et al. (2007) found that loggerhead hatchlings tested in a magnetic field of 52 microteslas swam eastward, and when the field was decreased to 43 microteslas, the hatchlings swam westward. Sea turtles also use nonmagnetic cues for navigation and migration, and these additional cues may compensate for variations in magnetic fields. Putman et al. (2015b) conducted experiments on loggerhead hatchlings and determined that electromagnetic fields may be more important for sea turtle navigation in areas that may constrain a turtle's ability to navigate (cold temperatures or displacement from a migration route). The findings of this study suggest that the magnetic orientation behavior of sea turtles is closely associated with ocean ecology and geomagnetic environment (Putman et al., 2015b).

Liboff (2015) determined that freshly hatched sea turtles are able to detect and use the local geomagnetic field as a reference point before embarking a post-hatchling migration. Liboff (2015) proposed that the information is transferred from the mother to the egg through some undetermined geomagnetic imprinting process (Liboff, 2015). Aspects of electromagnetic stressors that are applicable to marine organisms in general are described in Section 3.0.3.6.2 (Conceptual Framework for Assessing Effects from Energy-Producing Activities).

As stated in Section 3.0.3.3.3.1 (In-Water Electromagnetic Devices), the static magnetic fields generated by electromagnetic devices used in training and testing activities are of relatively minute strength. The maximum strength of the magnetic field is approximately 2,300 microteslas, with the strength of the field decreasing further from the device. At a distance of 4 m from the source of a 2,300-microtesla magnetic field, the strength of the field is approximately 50 microteslas, which is within the range of the Earth's magnetic field (25 to 65 microteslas). At 8 m, the strength of the field is approximately 40 percent of the Earth's magnetic field, and only 10 percent at 24 m away from a 2,300 microtesla magnetic field at the source. At a distance of 200 m the magnetic field would be approximately 0.2 microteslas (U.S. Department of the Navy, 2005), which is less than 1 percent of the strength of the Earth's magnetic field. This is likely within the range of detection for sea turtle species, but at the lower end of the sensitivity range.

Sheridan (2010) confirmed high degrees of site fidelity among terrapins returning to natal beaches, along with low dispersal distances, suggesting that long-distance navigation is not required of terrapins, and they likely rely on other environmental cues (e.g., visual cues, shoreline shape, currents). Terrapins and alligators, however, like other reptiles (Brothers & Lohmann, 2015; Mathis & Moore, 1988; Putman et al., 2015b), likely detect electromagnetic fields and can use them in some degree for orientation. For inshore reptiles, however, other cues are likely more important.

3.8.3.3.1.1 Impacts from In-Water Electromagnetic Devices under Alternative 1

Impacts from In-Water Electromagnetic Devices under Alternative 1 for Training Activities

As discussed in Section 3.0.3.3.3.1 (In-Water Electromagnetic Devices), offshore training activities that use in-water electromagnetic devices would occur within the Virginia Capes, Navy Cherry Point, Jacksonville, and Gulf of Mexico Range Complexes (see Table 3.0-15). In addition, training activities that use in-water electromagnetic devices would occur within inshore waters surrounding Boston, Massachusetts; Earle, New Jersey; Delaware Bay, Delaware; Hampton Roads, Virginia; Morehead City, North Carolina; Wilmington, North Carolina; Savannah, Georgia; Kings Bay; Georgia; Mayport, Florida; Port Canaveral; Florida; Tampa, Florida; Beaumont, Texas; and Corpus Christi, Texas (see Table 3.0-23) In-water electromagnetic devices would be used in areas potentially inhabited by sea turtles, American alligators, and diamondback terrapins.

Sea turtles would be potentially exposed to electromagnetic fields in offshore areas and nearshore areas where electromagnetic devices are used. Sea turtles are expected to be highly dispersed in offshore waters, and co-occurrence with training events is unlikely even in the Navy Cherry Point Range Complex and Virginia Capes Range Complex where the density of training activities using in-water electromagnetic devices is the highest. If located in the immediate area (within about 200 m) where electromagnetic devices are being used, adult, sub-adult, juvenile, and hatchling sea turtles of all species could deviate from their original movements, but the extent of this disturbance is likely to be inconsequential because of the low likelihood of a sea turtle occurring within 200 m of the device and the movement through the area of both the turtle and the device. In the event that an animal is exposed in these areas, a small behavioral disturbance (e.g., short disorientation) is unlikely to significantly impact an animal's behavior and fitness. Repeated exposures to animals are not anticipated as these offshore areas do not have resident animals year round. Given the very low number of events within inshore waters (see Table 3.0-23), the inshore water locations of where these devices would occur, and species' distribution, co-occurrence with individuals of any species is very unlikely, especially in northern inshore locations.

Potential impacts on sea turtles are not anticipated because any potential effects are likely limited to a few minor disturbances, which would be similar to natural stressors regularly occurring in the animal's life cycle. The electromagnetic devices used in training activities are not expected to cause more than a short-term behavioral disturbance to sea turtles because of the: (1) relatively low intensity of the magnetic fields generated (0.2 microteslas at 200 m from the source), (2) very localized potential impact area, and (3) temporary duration of the activities (hours). Potential impacts of exposure to electromagnetic stressors are not expected to result in substantial changes in an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment, and are not expected to result in population-level impacts.

American alligators may be exposed to electromagnetic fields in inshore training locations from North Carolina to Texas, while diamondback terrapins may be exposed to electromagnetic fields in all inshore training locations where electromagnetic devices are used under Alternative 1 (these locations are listed in Table 3.0-23). Electromagnetic fields generated by in-water training devices would likely have negligible effects on alligators and terrapins because of the (1) relatively low intensity of the magnetic fields generated (0.2 microteslas at 200 m from the source), (2) very localized potential impact area, (3) geography of inshore waters (e.g., mudflats, plants, islands, creeks) that likely further shield alligators and terrapins from electromagnetic fields, (4) temporary duration of the activities (hours), and (5) the reliance on other environmental cues for orientation. Potential impacts of exposure to electromagnetic stressors are not expected to result in substantial changes in an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment, and are not expected to result in population-level impacts for American alligators or diamondback terrapins.

Proposed training activities that use in-water electromagnetic devices would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy training activities that expend in-water electromagnetic devices would not occur within the southeast portion of loggerhead critical habitat that is designated as breeding areas, but would occur in the following loggerhead sea turtle critical habitat year round: nearshore reproductive habitat, winter areas, migration corridors, and *Sargassum* habitat. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. In-water electromagnetic device use has no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to the relatively weak strength of the electromagnetic fields created by these activities, the localized area potentially impacted by the electromagnetic fields, and the temporary duration of these activities.

Pursuant to the ESA, the use of electromagnetic devices during training activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and would have no effect on the ESA-listed American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and there would be no effect on

American crocodile critical habitat. The Navy has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.

Impacts from In-Water Electromagnetic Devices under Alternative 1 for Testing Activities

As discussed in Section 3.0.3.3.3.1 (In-Water Electromagnetic Devices), under Alternative 1, offshore testing activities use in-water electromagnetic devices would occur within the Virginia Capes, Navy Cherry Point, Jacksonville, and Gulf of Mexico Range Complexes, as well as the South Florida Ocean Measurement Facility, and the Naval Surface Warfare Center Panama City Testing Range (see Table 3.0-14). In addition, testing activities that use in-water electromagnetic devices would occur within inshore waters surrounding Little Creek, Virginia (see Table 3.0-15).

Only sea turtles and diamondback terrapins are analyzed for potential impacts for testing activities that use in-water electromagnetic devices under Alternative 1. For testing activities occurring within inshore waters near Little Creek, Virginia, most of the sea turtle species except the hawksbill sea turtle would be present. Given the limited location of where these devices would occur, and species' distribution in the area, which is limited to warmer months, co-occurrence with individuals is possible but unlikely in certain times of the year.

Sea turtles would be potentially exposed to electromagnetic fields in offshore areas and nearshore areas where electromagnetic devices are used. Sea turtles are expected to be highly dispersed in offshore waters, and co-occurrence with testing events is unlikely within areas used for testing activities (e.g., Virginia Capes, Navy Cherry Point, Jacksonville, and Gulf of Mexico Range Complexes), even in areas where sea turtle density is likely the highest (Virginia Capes and Navy Cherry Point Range Complexes). If located in the immediate area (within about 200 m) where electromagnetic devices are being used, adult, sub-adult, juvenile, and hatchling sea turtles could deviate from their original movements, but the extent of this disturbance is likely to be inconsequential because of the low likelihood of a sea turtle occurring within 200 m of the device and the movement through the area of both the turtle and the device. In addition, potential impacts on sea turtles are not anticipated because any potential effects are likely limited to a few minor disturbances, which would be similar to natural stressors regularly occurring in the animal's life cycle. The electromagnetic devices used in testing activities are not expected to cause more than a short-term behavioral disturbance to sea turtles because of the: (1) relatively low intensity of the magnetic fields generated (0.2 microteslas at 200 m from the source), (2) very localized potential impact area, and (3) temporary duration of the activities (hours). Potential impacts of exposure to electromagnetic stressors are not expected to result in substantial changes in an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment, and are not expected to result in population-level impacts.

Diamondback terrapins may be exposed to electromagnetic fields in inshore waters around Little Creek, Virginia, where electromagnetic devices are used under Alternative 1. Electromagnetic fields generated by in-water testing devices would likely have negligible effects on terrapins because of the (1) relatively low intensity of the magnetic fields generated (0.2 microteslas at 200 m from the source), (2) very localized potential impact area, (3) geography of inshore waters (e.g., mudflats, plants, islands, creeks) that likely further shield terrapins from electromagnetic fields, (4) temporary duration of the activities (hours), and (5) the reliance on other environmental cues for orientation. Potential impacts of exposure to electromagnetic stressors are not expected to result in substantial changes in an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment, and are not expected to result in population-level impacts for diamondback terrapins.

Proposed testing activities that use in-water electromagnetic devices would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy testing activities that expend in-water electromagnetic devices would not occur within the southeast portion of loggerhead critical habitat that is designated as breeding areas, but would occur in the following loggerhead sea turtle critical habitat year round: nearshore reproductive habitat, winter areas, migration corridors, and *Sargassum* habitat. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. In-water electromagnetic device use has no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to the relatively weak strength of the electromagnetic fields created by these activities, the localized area potentially impacted by the electromagnetic fields, and the temporary duration of these activities.

Pursuant to the ESA, the use of electromagnetic devices during testing activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and would have no effect on the ESA-listed American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat. The Navy has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.

3.8.3.3.1.2 Impacts from In-Water Electromagnetic Devices under Alternative 2

Impacts from In-Water Electromagnetic Devices under Alternative 2 for Training Activities

Because the locations, number of events, and potential effects associated with in-water electromagnetic devices would be the same under Alternatives 1 and 2, impacts experienced by sea turtles, American alligators, and diamondback terrapins from in-water electromagnetic devices use under Alternative 2 are not expected to be meaningfully different than those described under Alternative 1. Therefore, impacts associated with training activities under Alternative 2 are the same as Alternative 1.

Proposed training activities that use in-water electromagnetic devices would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy training activities that expend in-water electromagnetic devices would not occur within the southeast portion of loggerhead critical habitat that is designated as breeding areas, but would occur in the following loggerhead sea turtle critical habitat year round: nearshore reproductive habitat, winter areas, migration corridors, and *Sargassum* habitat. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. In-water electromagnetic device use has no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to the relatively weak strength of the electromagnetic fields created by these activities, the localized area potentially impacted by the electromagnetic fields, and the temporary duration of these activities.

Pursuant to the ESA, the use of electromagnetic devices during training activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and would have no effect on the ESA-listed American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and there would be no effect on American crocodile critical habitat.

Impacts from In-Water Electromagnetic Devices under Alternative 2 for Testing Activities

As discussed in Section 3.0.3.3.3.1 (In-Water Electromagnetic Devices) the locations, numbers of testing activities, and potential effects associated with in-water electromagnetic device use would be the same under Alternatives 1 and 2. Refer to Section 3.8.3.3.1.1 (Impacts from In-Water Electromagnetic Devices under Alternative 1) for a discussion of impacts on sea turtles and terrapins.

Proposed testing activities that use in-water electromagnetic devices would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy testing activities that expend in-water electromagnetic devices would not occur within the southeast portion of loggerhead critical habitat that is designated as breeding areas, but would occur in the following loggerhead sea turtle critical habitat year round: nearshore reproductive habitat, winter areas, migration corridors, and *Sargassum* habitat. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. In-water electromagnetic device use has no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to the relatively weak strength of the electromagnetic fields created by these activities, the localized area potentially impacted by the electromagnetic fields, and the temporary duration of these activities.

Pursuant to the ESA, the use of electromagnetic devices during testing activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and would have no effect on the ESA-listed American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and there would be no effect on American crocodile critical habitat.

3.8.3.3.1.3 Impacts from In-Water Electromagnetic Devices under the No Action Alternative

Impacts from In-Water Electromagnetic Devices under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various energy stressors (e.g., in-water electromagnetic devices) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.8.3.3.2 Impacts from In-Air Electromagnetic Devices

The use of in-air electromagnetic devices associated with Navy training and testing activities is not applicable to reptiles because in-air electromagnetic energy does not penetrate the ocean, nor will use of these devices be close enough in proximity to sea turtle nesting locations to have an effect on these animals. As a result, in-air electromagnetic devices will not be analyzed further in this section.

3.8.3.3.3 Impacts from High-Energy Lasers

As discussed in Section 3.0.3.3.3.3 (Lasers), high-energy laser weapons training and testing involves the use of up to 30 kilowatts of directed energy as a weapon against small surface vessels and airborne targets. These weapons systems are deployed from surface ships and helicopter to create small but critical failures in potential targets and used at short ranges from the target.

This section analyzes the potential impacts of high-energy lasers on sea turtles. As discussed in Section 3.0.3.3.3.3 (Lasers), high-energy laser weapons are designed to disable surface targets, rendering them immobile. High-energy lasers would only be used in open ocean areas for training and testing activities; therefore, crocodilian and terrapin species are not included in the analysis for potential impacts from high-energy lasers because they would not be located in areas where high-energy lasers would be used.

The primary concern for high-energy weapons training and testing is the potential for a sea turtle to be struck by a high-energy laser beam at or near the water's surface, which could result in injury or death, resulting from traumatic burns from the beam.

Sea turtles could be exposed to a laser only if the beam missed the target. Should the laser strike the sea surface, individual sea turtles at or near the surface could be exposed. The potential for exposure to a high energy laser beam decreases as the water depth increases. Because laser platforms are typically helicopters and ships, sea turtles at sea would likely transit away or submerge in response to other stressors, such as ship or aircraft noise, although some sea turtles would not exhibit a response to an oncoming vessel or aircraft, increasing the risk of contact with the laser beam.

3.8.3.3.3.1 Impacts from High-Energy Lasers under Alternative 1

Impacts from High-Energy Lasers under Alternative 1 for Training Activities

As discussed in Section 3.0.3.3.3.3 (Lasers), high-energy laser use associated with training activities would occur within the Virginia Capes and Jacksonville Range Complexes. For safety reasons, high energy lasers would not be used in nearshore or inshore training locations. Navy training activities have the potential to expose sea turtles that occur within these areas to this energy stressor.

Appendix F (Military Expended Materials and Direct Strike Impact Analyses) includes a conservative probability estimate for a direct laser strike on a sea turtle during training activities. The analysis is over-predictive and conservative in that it assumes: (1) that all sea turtles would be at or near the surface 100 percent of the time, and would not account for the duration of time a sea turtle would be diving; and (2) that sea turtles are stationary, which does not account for any movement or any potential avoidance of the training or testing activity in response to other stressors (e.g., vessel noise). Loggerhead sea turtles have the highest seasonal density within these areas where high-energy lasers would be used; therefore, for the sake of conservatively estimating the potential for direct strike of sea turtles by a high-energy laser, loggerheads are used as a proxy in the modeling for estimating impacts on all sea turtle species within the AFTT Study Area. As shown in Appendix F (Military Expended Materials and Direct Strike Impact Analyses) the probability for a direct strike on a sea turtle is extremely low. The modeling results show that 0.000008 loggerhead sea turtles would be exposed to a high-energy laser strike. Based on the assumptions used in the statistical probability analysis, there is a high level of certainty in the conclusion that no sea turtles of any species that occur in the Study Area would be struck by a high-energy laser. Potential impacts of exposure to high-energy lasers are not expected to result in substantial changes in an individual’s behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment, and are not expected to result in population-level sea turtles.

Proposed training activities that use high-energy lasers would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy training activities that use high-energy lasers would not occur within the southeast portion of loggerhead critical habitat that is designated as breeding areas or nearshore reproductive habitats, but would occur in the following loggerhead turtle critical habitat year round: winter areas, migration corridors, and *Sargassum* habitat. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. High-energy laser use has no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to the directed energy of the laser, the dissipation of energy as water depth increases, and the temporary duration of the activities. (National Marine Fisheries Service, 2014b)

Pursuant to the ESA, the use of high-energy lasers during training activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and will have no effect on the ESA-listed American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat. The Navy has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.

Impacts from High-Energy Lasers under Alternative 1 for Testing Activities

As discussed in Section 3.0.3.3.3.3 (Lasers), high-energy laser tests would occur within the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Gulf of Mexico, and Key West Range Complexes. High-energy laser testing activities would also be conducted within the Naval Undersea Warfare Center, Newport Testing Range, South Florida Ocean Measurement Facility, and the Naval Surface Warfare Center Panama City Testing Range. Navy testing activities have the potential to expose sea turtles that occur within these locations to this energy stressor. The sea turtle species with the highest average seasonal density (loggerhead sea turtle) in the location with the greatest number of testing activities involving high-energy lasers under Alternative 1 (Virginia Capes Range Complex) was used in the probability analysis.

Appendix F (Military Expended Materials and Direct Strike Impact Analyses) includes a conservative probability estimate for a direct laser strike on a sea turtle during testing activities. Using the same methods and assumptions described above, the modeling results show that 0.000136 loggerhead sea turtles would be exposed to a high-energy laser strike. Based on the assumptions used in the statistical probability analysis, there is a high level of certainty in the conclusion that no sea turtle of any species that occur in the Study Area would be struck by a high-energy laser.

Proposed testing activities that use high-energy lasers would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy testing activities that use high-energy lasers would not occur within nearshore reproductive habitats, but would occur in the following loggerhead turtle critical habitat year round: breeding areas, winter areas, migration corridors, and *Sargassum* habitat. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. High-energy laser use has no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to the directed energy of the laser, the dissipation of energy as water depth increases, and the temporary duration of the activities.(National Marine Fisheries Service, 2014b)

Pursuant to the ESA, the use of high-energy lasers during testing activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and will have no effect on the ESA-listed American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA in that regard.

3.8.3.3.3.2 Impacts from High-Energy Lasers under Alternative 2

Impacts from High-Energy Lasers under Alternative 2 for Training Activities

The locations, number of events, and potential effects associated with high-energy lasers would be the same under Alternatives 1 and 2. Refer to Section 3.8.3.3.3.1 (Impacts from High-Energy Lasers under Alternative 1) for a discussion of impacts on sea turtles.

Proposed training activities that use high-energy lasers would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy training activities that use high-energy lasers would not occur within the southeast portion of loggerhead critical habitat that is designated as breeding areas or nearshore reproductive habitats, but would occur in the following loggerhead turtle critical habitat year round: winter areas, migration corridors, and *Sargassum* habitat. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. High-energy laser use has no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to the directed energy of the laser, the dissipation of energy as water depth increases, and the temporary duration of the activities.(National Marine Fisheries Service, 2014b)

Pursuant to the ESA, the use of high-energy lasers during training activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and will have no effect on the ESA-listed American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat.

Impacts from High-Energy Lasers under Alternative 2 for Testing Activities

The locations, number of events, and potential effects associated with high-energy laser use would be the same under Alternatives 1 and 2. Refer to Section 3.8.3.3.3.1 (Impacts from High-Energy Lasers under Alternative 1) for a discussion of impacts on sea turtles.

Proposed testing activities that use high-energy lasers would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy testing activities that use high-energy lasers would not occur within nearshore reproductive habitats, but would occur in the following loggerhead turtle critical habitat year round: breeding areas, winter areas, migration corridors, and *Sargassum* habitat. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. High-energy laser use has no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to the directed energy of the laser, the dissipation of energy as water depth increases, and the temporary duration of the activities.(National Marine Fisheries Service, 2014b)

Pursuant to the ESA, the use of high-energy lasers during testing activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and will have no effect on the ESA-listed American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat.

3.8.3.3.3.3 Impacts from High-Energy Lasers under the No Action Alternative

Impacts from High-Energy Lasers under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the proposed training or testing activities in the AFTT Study Area. Various energy stressors (e.g., high-energy lasers) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.8.3.4 Physical Disturbance and Strike Stressors

This section analyzes the potential impacts of the various types of physical disturbance and strike stressors used by Navy during training and testing activities within the Study Area. The physical disturbance and strike stressors that may impact reptiles and include: (1) Navy vessels and in-water devices; (2) military expended materials, including non-explosive practice munitions and fragments from high-explosive munitions; and (3) seafloor devices. General discussion of impacts can also be found in Section 3.0.3.6.3 (Conceptual Framework for Assessing Effects from Physical Disturbance or Strike).

The way a physical disturbance may affect a reptile would depend in part on the relative size of the object, the speed of the object, the location of the reptile in the water column, and the behavioral reaction of the sea turtle. It is not known at what point or through what combination of stimuli (visual, acoustic, or through detection in pressure changes) a reptile becomes aware of a vessel or other potential physical disturbances prior to reacting or being struck.

Like marine mammals, if a reptile reacts to physical disturbance, the individual must stop its activity and divert its attention in response to the stressor. The energetic costs of reacting to a stressor will depend on the specific situation, but one can assume that the caloric requirements of a response may reduce the amount of energy available for other biological functions.

For sea turtles who have resident home ranges near Navy activities, the relative concentration of Navy vessels would cause sea turtles to respond repeatedly to the exposure. This repeated response would interrupt normal daily routines (e.g., foraging activities) more often than resident near-shore turtles not near Navy installations or in open ocean areas where Navy vessel traffic is less concentrated, though animals may become habituated to repeated stimuli. If a strike does occur, the cost to the individual could range from slight injury to death.

Diamondback terrapins may be exposed to potential physical disturbance and strike hazards in all inshore training and testing locations. American alligators may be exposed in all inshore training and testing locations along the Atlantic coast from North Carolina to Florida, and along the Gulf coast from Florida to Texas. As with sea turtles, impacts of any potential strike of alligators or terrapins could range from slight injury to death. American crocodiles are not included in the analysis for physical disturbance and strike stressors because of the very low likelihood of a strike. Navy vessel presence would be unlikely in American crocodile habitat, which consists of shallow nearshore habitat in southern Florida; however, it is possible that American crocodiles could be occasionally exposed to Navy vessel noise, mostly from smaller support vessels (see Section 3.8.3.1.5, Impacts from Vessel Noise, for an analysis of acoustic stressor responses by crocodilians). Therefore, American crocodiles are not analyzed for potential impacts from physical disturbance and strike stressors.

3.8.3.4.1 Impacts from Vessels and In-Water Devices

Vessels

The majority of the training and testing activities under all alternatives involve some level of vessel activity. For a discussion on the types of activities that use vessels see Appendix B (Activity Stressor Matrices). Section 3.0.3.3.4.1 (Vessels and In-Water Devices) Table 3.0-17 provides a list of representative vessels used in training and testing activities, along with vessel lengths and speeds used in training and testing activities.

Within the AFTT Study Area, commercial traffic is heaviest in the nearshore waters, near major ports and in the shipping lanes along the entire United States East Coast and along the northern coast of the Gulf of Mexico while Navy vessel traffic is primarily concentrated between the mouth of the Chesapeake Bay, Virginia and Jacksonville, Florida (Mintz, 2012). An examination of vessel traffic within the AFTT Study Area determined that Navy vessel occurrence is two orders of magnitude lower than that of commercial traffic. The study also revealed that, while commercial traffic is relatively steady throughout the year, Navy vessel usage within the range complexes is episodic, based on specific exercises being conducted at different times of the year (Mintz, 2012); however, Navy vessel use within inshore waters occurs regularly and primarily consists of high-speed small vessel movements. These high-speed vessel movements in near shore and inshore waters present a relatively higher risk for strike (Hazel et al., 2007) because of the higher concentrations of sea turtles in these areas and the difficulty for vessel operators to avoid collisions in high-speed activities.

Strikes of sea turtles, American alligators, and diamondback terrapin could cause permanent injury or death from bleeding or other trauma, paralysis and subsequent drowning, infection, or inability to feed. Apart from the severity of the physical strike, the likelihood and rate of recovery from a strike may be influenced by the animal’s age, reproductive state, and general condition. Much of what is written about recovery from vessel strikes is inferred from observing individuals some time after a strike.

Numerous sea turtles bear scars that appear to have been caused by propeller cuts or collisions with vessel hulls (Hazel et al., 2007; Lutcavage et al., 1997). Fresh wounds on some stranded animals may strongly suggest a vessel strike as the cause of death. The actual incidence of recovery versus death is not known, given available data. Any sea turtle species found in the Study Area can occur at or near the surface in open ocean and coastal areas, whether feeding or periodically surfacing to breathe.

Sea turtles spend a majority of their time submerged (Renaud & Carpenter, 1994; Sasso & Witzell, 2006), though Hazel et al. (2009) and Hazel et al. (2007) showed turtles staying within the top 3 m of water despite deeper water being available. Loggerhead turtles are the most abundant sea turtles found in the nearshore environment of the Study Area. Loggerheads, considered to be the most generalist of sea turtle species in terms of feeding and foraging behavior, apparently exhibit varied dive behavior that is linked to the quantity and quality of available resources. Leatherback turtles are more likely to feed at or near the surface in open ocean areas. It is important to note that leatherbacks can forage for jellyfish at depth but bring them to the surface to ingest (Benson et al., 2007; Fossette et al., 2007; James & Herman, 2001). Basking on the water’s surface is common for all species within the Study Area as a strategy to thermoregulate, and the reduced activity associated with basking may pose higher risks for sea turtle strikes because of a likely reduced capacity to avoid cues. Green, hawksbill, loggerhead, and

Kemp's ridley sea turtles are more likely to forage nearshore, and although they may feed along the seafloor, they surface periodically to breathe while feeding and moving between near-shore habitats. Kemp's ridleys can spend extended periods foraging at depth, even in open ocean areas (Sasso & Witzell, 2006; Seney, 2016; Servis et al., 2015).

Smaller, faster vessels that operate in nearshore waters, where green, Kemp's ridley, loggerhead sea turtles can be more densely concentrated, pose a greater risk (Chaloupka et al., 2008). For example, sea turtle occurrence (e.g., Kemp's ridleys and loggerheads) increases in nearshore areas within Chesapeake Bay from late spring to early fall, most likely due to foraging (Barco & Lockhart, 2015). Other studies have shown that the potential for vessel strike increases in areas important for foraging sea turtles (Denkinger et al., 2013).

Vessels transiting in shallow waters to and from ports travel at slower speed and pose less risk of strikes to sea turtles (Hazel et al., 2007; Lutcavage et al., 1997). It should be noted that no known instances of vessel strikes to sea turtles by a Navy vessel have been reported for the Study Area.

The American alligator and diamondback terrapin are also subject to potential vessel strikes in inshore waters. The diamondback terrapin may be exposed to potential strike within all inshore training and testing locations, while the American alligator would be exposed to potential strike in inshore training and testing locations along the Atlantic coast from North Carolina to Florida, and along the Gulf Coast from Florida to Texas.

American alligators may exhibit avoidance behaviors in relatively open waters in the presence of recreational boating traffic. Lewis et al. (2014) observed that alligators avoided open waters of the Fort Worth Nature Center and Refuge located on the Trinity River in Texas, at least in part due to the presence of recreational boaters. Based off of field observations, Lewis et al. (2014) noted that both motorized and non-motorized boats commonly approached alligators, which may have resulted in alligators avoiding the open water where detection by boaters would have been more likely. Grant and Lewis (2010) noted in a study on spectacled caiman (*Caiman crocodilus*) in the Tortuguero region of Costa Rica found that increasing boat traffic associated with ecotourism, recreation, and local human population growth increased the likelihood of boat-collision–related injuries. Spectacled caiman were also frequently observed avoiding boats (Grant & Lewis, 2010). Grant and Lewis (2010) also noted that collisions with boats were more likely to occur in relatively more narrow channels where crocodilians had less maneuverable space within the channel to avoid the boat, as substantiated by observations of American crocodile scars on tails. With American alligator population increases in recent years (Savannah River Ecology Laboratory & Herpetology Program, 2012) and expansion into many parts of their historical range (Smith et al., 2016), incidents of collisions with boats will likely increase. However, alligators likely exhibit avoidance behaviors both in the presence of vessels and avoid areas with high amounts of recreational boat traffic.

Hearing sensitivities of terrapins have been shown to overlap with boat engine sounds. However, the lack of observed behavioral responses to approaching vessels can present strike risk to terrapins, particularly in high-density, small vessel recreation areas (Lester et al., 2012; Lester, 2013). Therefore, terrapins may be at relatively higher risk to potential strike compared to crocodilians where vessel traffic occurs, not because of an inability to hear approaching vessels, but because terrapins do not exhibit avoidance behaviors.

In-Water Devices

In-water devices are generally smaller (several inches to 111 ft.) than most Navy vessels. Devices that could pose a collision risk to reptiles are those operated at high speeds and are unmanned. For a discussion on the types of activities that use in-water devices see Appendix B (Activity Stressor Matrices), and for information on where in-water devices are used, and how many activities would occur under each alternative, see Section 3.0.3.3.4.1 (Vessels and In-Water Devices).

The Navy reviewed torpedo design features and a large number of previous anti-submarine warfare torpedo exercises to assess the potential of torpedo strikes on marine mammals, and its conclusions are also relevant to reptiles. The acoustic homing programs of Navy torpedoes are sophisticated and would not confuse the acoustic signature of a marine mammal with a submarine/target. It is reasonable to assume that acoustic signatures of sea turtles would also not be confused with a submarine or target. All exercise torpedoes are recovered and refurbished for eventual re-use. Review of the exercise torpedo records indicates there has never been an impact on a sea turtle or other reptile. In thousands of exercises in which torpedoes were fired or in-water devices used, there have been no recorded or reported instances of a marine species strike from a torpedo or any other in-water device.

Since some in-water devices are identical to support craft (typically less than 15 m in length), reptiles could respond to the physical presence of the device similar to how they respond to the physical presence of a vessel. Physical disturbance from the use of in-water devices is not expected to result in more than a momentary behavioral response. These responses would likely include avoidance behaviors (swimming away or diving) and cessation of normal activities (e.g., foraging). As with an approaching vessel, not all sea turtles would exhibit avoidance behaviors and therefore would be at higher risk of a strike.

In-water devices, such as unmanned underwater vehicles, that move slowly through the water are highly unlikely to strike reptiles because the animal could easily avoid the object. Towed devices are unlikely to strike a sea turtle because of the observers on the towing platform and other standard safety measures employed when towing in-water devices. Reptiles that occur in areas that overlap with in-water device use within the Study Area may encounter in-water devices. It is possible that reptiles may be disturbed by the presence of these activities, but any disturbance from the use of in-water devices is not expected to result in more than a temporary behavioral response.

3.8.3.4.1.1 Impacts from Vessels and In-Water Devices under Alternative 1

Section 3.0.3.3.4.1 (Vessels and In-Water Devices) provides estimates of relative vessel and in-water device use and location throughout the Study Area. Under Alternative 1 the concentration of vessel and in-water device use and the manner in which the Navy trains and tests would remain consistent with the levels and types of activity undertaken in the AFTT Study Area over the last decade. Consequently, the Navy does not foresee any appreciable changes in the levels, frequency, or locations where vessels have been used over the last decade, and therefore the level at which physical disturbance and strikes are expected to occur is likely to remain consistent with the previous decade.

Impacts from Vessels and In-Water Devices under Alternative 1 for Training Activities

As indicated in Section 3.0.3.3.4.1 (Vessels and In-Water Devices), most training activities involve large vessel movement. The potential for vessel strikes to reptiles are not associated with any specific training activity but rather a limited, sporadic, and accidental result of Navy ship movement within the Study Area, occurring in both offshore and inshore water areas. Vessel movement can be widely dispersed throughout the AFTT Study Area but for the most part occurs within the established range complexes and is more concentrated near naval ports, piers, and range areas. Training activities that include vessel movements in the offshore waters of the Study Area would primarily be conducted within the Virginia Capes, Navy Cherry Point, and Jacksonville Range Complexes, but would also be conducted within the Northeast, Key West, and Gulf of Mexico Range Complexes, as well as other offshore AFTT areas. Offshore vessel movements would be widely dispersed throughout the Study Area, but are more concentrated near ports, naval installations, range complexes and testing ranges. Large vessel movement primarily occurs within the U.S. Exclusive Economic Zone, with the majority of the traffic flowing between Naval Stations Norfolk and Mayport (see Table 3.0-18).

Vessel movements associated with training activities within inshore waters would occur within or near Boston, Massachusetts; Groton, Connecticut; Narragansett, Rhode Island; Earle, New Jersey; Delaware Bay, Delaware; James River and tributaries, Virginia; York River, Virginia; the Lower Chesapeake Bay, Virginia; Hampton Roads, Virginia; Norfolk, Virginia; Morehead City, North Carolina; Wilmington, North Carolina; Cooper River, South Carolina; Savannah, Georgia; Kings Bay, Georgia; Mayport, Florida; St. Johns River, Florida; Port Canaveral, Florida; Tampa, Florida; St. Andrew Bay, Florida; Beaumont, Texas, and Corpus Christi, Texas. In addition, high-speed small vessel movements would be conducted within inshore waters including and surrounding Narragansett Bay, Rhode Island; James River and tributaries, Virginia; York River, Virginia; the Lower Chesapeake Bay; Coopers River, South Carolina; Mayport, Florida; St. Johns River, Florida; Port Canaveral, Florida; and St. Andrew Bay, Florida (see Table 3.0-18 through Table 3.0-20).

As discussed in Section 3.0.3.3.4.1 (Vessels and In-Water Devices), in-water devices include unmanned surface vehicles, unmanned underwater vehicles, and towed devices. Under Alternative 1, offshore training activities involving the use of in-water devices would be conducted within the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes, the Naval Surface Warfare Center Panama City Testing Range, and other offshore AFTT areas. Training activities that use in-water devices would also occur within inshore waters including and surrounding Boston, Massachusetts; Earle, New Jersey; Delaware Bay, Delaware; Hampton Roads, Virginia; the Lower Chesapeake Bay, Virginia; James River and tributaries, Virginia; York River, Virginia; Morehead City, North Carolina; Wilmington, North Carolina; Savannah, Georgia; Kings Bay, Georgia; Mayport, Florida; Port Canaveral, Florida; Tampa, Florida; St. Andrew Bay, Florida; Beaumont, Texas; and Corpus Christi, Texas.

Under Alternative 1 training activities, sea turtles may be exposed to strike risk in all inshore and offshore areas where vessels and in-water devices would operate. American alligators may be exposed to vessel strike at Morehead City, North Carolina; Cooper River, South Carolina; Savannah, Georgia; Kings Bay, Georgia; Mayport, Florida; St. Johns River, Florida; Port Canaveral, Florida; Tampa, Florida; St. Andrew Bay, Florida; Beaumont, Texas, and Corpus Christi, Texas. Diamondback terrapins may be exposed to strike at all inshore training locations.

Under Alternative 1, sea turtle, alligator, and terrapin strikes would most likely occur where there is a co-location of these reptile species, especially in high densities, and with high-speed vessel and in-water device training activities. Over the continental shelf, sea turtles are at risk of strikes because of greater densities of sea turtles and more frequent vessel movements relative to the open ocean. Therefore, sea turtle species that occur over the continental shelf and in inshore waters (e.g., estuaries), would therefore have a greater potential for impacts. This suggests that loggerhead sea turtles are likely the most at risk of vessel interactions and in-water devices under Alternative 1 in the open ocean, as well as within inshore waters where small and fast vessels conduct activities because this species is the most abundant in the Range Complexes and inshore waters (e.g., Lower Chesapeake Bay) that have the highest concentration of training activities involving vessel movement. There is not expected to be any predictable seasonal difference in Navy vessel use; therefore, impacts from vessels and in-water devices, including physical disturbance and potential for strike, would depend on each species' seasonal patterns of occurrence or degree of residency in the continental shelf and inshore waters portions of the AFTT Study Area. As previously indicated, any physical disturbance from vessel transit and use of in-water devices is not expected to result in more than a momentary behavioral response; however, an actual strike of a reptile would likely result in permanent injury, temporary injury that weakens a sea turtle's resilience to other natural and human-induced stressors, death. In-water devices have a very limited potential to strike a sea turtle, alligator, or terrapin because they either move slowly through the water column (e.g., most unmanned underwater vehicles) or are closely monitored by observers manning the towing platform (e.g., most towed devices).

Although the likelihood is low, a harmful interaction with a vessel or in-water device in the open ocean cannot be discounted. In addition, more frequent vessel movements would occur in nearshore and inshore waters where sea turtles may congregate. Sea turtles often congregate close to shorelines during the breeding season, where vessel traffic is denser (Schofield et al., 2010). Activities within these areas present a higher likelihood of vessel strike of a sea turtle. Any of the sea turtle species found in the Study Area can occur at or near the surface in open-ocean and coastal areas or inshore waters, whether feeding, periodically surfacing to breathe, or basking (a behavior more common in cooler water and seasons). Leatherback turtles are more likely to feed at or near the surface in open ocean areas. Green, hawksbill, Kemp's ridley, and loggerhead turtles are more likely to forage nearshore, and although they may feed along the seafloor, they surface periodically to breathe while feeding and moving between nearshore habitats. These species, except for Hawksbill turtles, are distributed widely in all offshore portions of the Study Area.

The leatherback turtle is likely to be impacted by these activities, given its preference for open-ocean habitats and its feeding behavior (feed at the surface and throughout the water column) and prey (e.g., jellyfish). Hatchlings and pre-recruitment juveniles of all sea turtle species may also occur in open-ocean habitats, where they reside among *Sargassum* mats. Sea turtles are expected to be highly dispersed in deeper offshore waters and given the large area over which Navy vessels could potentially conduct training activities, the likelihood of co-occurrence is low, as well as the potential consequences.

Training activities that include vessel movements in the inshore waters of the Study Area occur on a more regular basis than the offshore activities, and often involve the vessels traveling at speeds greater than 10 knots (see Section 3.0.3.3.4.1, Vessels and In-Water Devices). Generally these inshore water activities are conducted in more confined waterways than activities occurring in the offshore waters, limiting maneuverability of the vessel, especially when trying to avoid a potential collision with a reptile. High-speed vessel movements further increase the potential risk of vessel strikes by reducing the available reaction time of both the animal and vessel operator to an impending strike. Hazel et al. (2007) noted in one study that green sea turtles did not have time to react to vessels moving at speeds of about 10 knots, but reacted frequently to vessels at speeds of about two knots. Detection, therefore, was suggested to be based on the turtle's ability to see rather than hear an oncoming vessel. Boat strike has been identified as one of the important mortality factors in several nearshore sea turtle habitats worldwide. Precise data are lacking for sea turtle mortalities directly caused by vessel strikes; however, live and dead turtles are often found with injuries indicative of collision with a vessel hull or propeller

(Hazel et al., 2007; Lutcavage et al., 1997). For example, Barco et al. (2016) found that out of the 60 fresh, dead loggerhead turtles that were examined from 2004 to 2013 in Virginia, 15 (25 percent) showed signs of vessel interactions. Scientists in Hawaii reported that 2.5 percent of green turtles found dead on the beaches between 1982 and 2003 had been killed by vessel strike (Chaloupka et al., 2008). Given the high amount of high-speed vessel movement hours, the inshore water locations of where these activities would occur (Table 3.0-20), and species' distribution throughout the Study Area, co-occurrence with individuals of loggerhead, green, Kemp's ridley, and leatherback turtles are very likely, especially in the Lower Chesapeake Bay, Virginia.

Any collision with a sea turtle would result in injury, and possible mortality, of an individual sea turtle. Under Alternative 1 training activities, the Navy will continue to implement procedural mitigation to avoid or reduce the potential for vessel and in-water device strike of sea turtles (see Section 5.3.4.1, Vessel Movement, and Section 5.3.4.2, Towed In-Water Devices). Within a mitigation zone of a vessel or in-water device, trained observers will relay sea turtle locations to the operators, who are required to change course (no course change would be implemented if the vessel's safety is threatened, the vessel is restricted in its ability to maneuver (e.g., during launching and recovery of aircraft or landing craft, during towing activities, when mooring, etc.), or if the in-water device is operated autonomously. A mitigation zone size is not specified for sea turtles to allow flexibility based on vessel type and mission requirements (e.g., small boats operating in a narrow harbor).

Potential impacts of exposure to vessels may result in substantial changes in an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment. Given the number of high-speed vessel hours in the inshore water locations, and the density of sea turtles in the area, the possibility of a strike to an individual of any species cannot be discounted. Any strike at high speed is likely to result in significant injury. Potential impacts of exposure to vessels are not expected to result in population-level impacts for all sea turtle species.

Strike potential in inshore training locations for American alligators under Alternative 1 training activities would likely range from minor survivable injuries to death of individual alligators. Based on avoidance behaviors, as shown in open water locations with motorized and non-motorized boat traffic, strike potential is likely reduced. Potential impacts of exposure to vessels and in-water devices may result in substantial changes in an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment. Given the number of high-speed vessel hours in the inshore water locations, and the density of alligators in training locations, the possibility of a strike to an individual alligator cannot be discounted. Any strike at high speed is likely to result in significant injury. Potential impacts of exposure to vessels are not expected to result in population-level impacts for American alligators.

Strike potential in inshore training locations for the diamondback terrapin under Alternative 1 training activities would likely range from major injuries (because of the relatively small body mass and body type of terrapins) and death. Boat strikes are a significant concern in terrapin conservation efforts (Lester et al., 2012; Lester, 2013). Potential impacts of exposure to vessels and in-water devices may result in substantial changes in an individual terrapin's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment. Given the number of high-speed vessel hours in the inshore water locations, and the density of terrapins in training locations, the possibility of a strike to an individual terrapin cannot be discounted. Any strike at high speed is likely to result in significant injury. Potential impacts of exposure to vessels are not expected to result in population-level impacts for diamondback terrapins.

Proposed training activities under Alternative 1 that use vessels and in-water devices would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy training activities that use vessels and in-water devices would occur year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Vessels have no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b). For example, training activities that use vessels and in-water devices will not impact the prey species found in *Sargassum* habitat or the nearshore habitat conditions that are essential for nearshore reproductive habitat.

Pursuant to the ESA, the use of vessels and in-water devices during training activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and would have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Vessels and In-Water Devices under Alternative 1 for Testing Activities

As indicated in Section 3.0.3.3.4.1 (Vessels and In-Water Devices), most of the testing activities involve large vessel movement. However, the number of activities that involve large vessel movements for testing is comparatively lower than the number of training activities. In addition, testing often occurs jointly with a training event, so it is likely that the testing activity would be conducted from a training vessel. Vessel movement in conjunction with testing activities could be widely dispersed throughout the Study Area, but would be concentrated near naval ports, piers, range complexes, testing ranges, and especially off the northeast U.S. coast, off south Florida, and in the Gulf of Mexico. Specifically, offshore testing activities that include vessels would be conducted within the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes, the Naval Undersea Warfare Center, Newport Testing Range; South Florida Ocean Measurement Facility Testing Range; Naval Surface Warfare Center, Panama City Division Testing Range (see Table 3.0-18).

Propulsion testing, which sometimes include ships operating at speeds in excess of 30 knots, occur infrequently but may pose a higher strike risk for reptiles (and primarily sea turtles because this activity would be conducted in offshore waters). This activity requires some vessels to transit at high speeds to complete the testing activity. These activities would occur in the Northeast, Virginia Capes, Jacksonville, and Gulf of Mexico Range Complexes. However, there are just a few of these events proposed per year, so the increased risk is nominal compared to all vessel use proposed for testing activities under Alternative 1.

In addition, vessel movements associated with testing activities would occur within inshore waters surrounding Bath, Massachusetts; Portsmouth, New Hampshire; Newport, Rhode Island; Groton, Connecticut; Little Creek, Virginia; Norfolk, Virginia; Kings Bay, Georgia; Mayport, Florida; Port Canaveral, Florida; and Pascagoula, Mississippi (see Table 3.0-19).

Also, as discussed in Section 3.0.3.3.4.1 (Vessels and In-Water Devices), testing activities involving the use of in-water devices would occur in the AFTT Study Area at any time of year. Under Alternative 1, testing activities involving the use of in-water devices would be conducted throughout the AFTT Study Area, including the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of

Mexico Range Complexes, the Naval Undersea Warfare Center, Newport Testing Range, South Florida Ocean Measurement Facility, and the Naval Surface Warfare Center Panama City Testing Range.

As with training activities, sea turtle, alligator, or terrapin strikes resulting from testing activities would most likely occur where there is a co-location of these reptile species, especially in high densities, and with high-speed vessel and in-water device testing activities. Over the continental shelf, sea turtles are at risk of strikes because of greater densities of sea turtles and more frequent vessel movements relative to the open ocean. Therefore, sea turtle species that occur over the continental shelf and in inshore waters (e.g., estuaries), would therefore have a greater potential for impacts. Loggerhead sea turtles are likely the most at risk of vessel interactions under Alternative 1 in the open ocean, as well as within inshore waters where small and fast vessels conduct activities. There is not expected to be any predictable seasonal difference in Navy vessel use; therefore, impacts from vessels and in-water devices, including physical disturbance and potential for strike, would depend on each species' seasonal patterns of occurrence or degree of residency in the continental shelf portions of the AFTT Study Area. As previously indicated, any physical disturbance from vessel transit and use of in-water devices is not expected to result in more than a momentary behavioral response; however, an actual strike of a sea turtle would likely result in permanent injury, temporary injury that weakens a sea turtle's resilience to other natural and human-induced stressors, death. Although the likelihood is low, a harmful interaction with a vessel or in-water device cannot be discounted during a testing activity.

Any collision with a sea turtle would result in injury, and possible mortality, of an individual sea turtle. Under Alternative 1 testing activities, the Navy will continue to implement procedural mitigation to avoid or reduce the potential for vessel and in-water device strike of sea turtles (see Section 5.3.4.1, Vessel Movement, and Section 5.3.4.2, Towed In-Water Devices). Within a mitigation zone of a vessel or in-water device, trained observers will relay sea turtle locations to the operators, who are required to change course (no course change would be implemented if the vessel's safety is threatened, the vessel is restricted in its ability to maneuver (e.g., during launching and recovery of aircraft or landing craft, during towing activities, when mooring, etc.), or if the in-water device is operated autonomously. A mitigation zone size is not specified for sea turtles to allow flexibility based on vessel type and mission requirements (e.g., small boats operating in a narrow harbor).

The leatherback turtle is likely to be impacted by testing activities using vessels and in-water devices, given its preference for open-ocean habitats and its feeding behavior (feed at the surface and throughout the water column) and prey (e.g., jellyfish). Hatchlings and pre-recruitment juveniles of all sea turtle species may also occur in open-ocean habitats, where they reside among *Sargassum* mats. Sea turtles are expected to be highly dispersed in deeper offshore waters; given the large area over which Navy vessels could potentially conduct testing activities, the likelihood of co-occurrence is low, as well as the potential consequences.

American alligators may be exposed to vessel strike during testing activities at inshore testing locations in Georgia, Florida, and Mississippi. Diamondback terrapins may be exposed to strike at all inshore testing locations along the Atlantic and Gulf coasts.

Strike potential in inshore testing locations for American alligators under Alternative 1 testing activities would likely range from minor survivable injuries to death of individual alligators. Based on avoidance behaviors, as shown in open-water locations with motorized and non-motorized boat traffic, strike potential is likely reduced. Potential impacts of exposure to vessels and in-water devices may result in substantial changes in an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment. Given the number of testing activities involving vessel movement in inshore locations, and the density of alligators in testing locations, the possibility of a strike to an individual alligator cannot be discounted. Any strike at high speed is likely to result in significant injury. Potential impacts of exposure to vessels are not expected to result in population-level impacts for American alligators.

Strike potential in inshore testing locations for the diamondback terrapin under Alternative 1 testing activities would likely range from major injuries (because of the relatively small body mass and body type of terrapins) and death. Boat strikes are a significant concern in terrapin conservation efforts (Lester et al., 2012; Lester, 2013). Potential impacts of exposure to vessels and in-water devices may result in substantial changes in an individual terrapin's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment. Given the number of testing activities involving vessel movement in inshore locations, and the density of terrapins in testing locations, the possibility of a strike to an individual terrapin cannot be discounted. Any strike at high speed is likely to result in significant injury. Potential impacts of exposure to vessels are not expected to result in population-level impacts for the diamondback terrapin.

Proposed testing activities under Alternative 1 that use vessels and in-water devices would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy testing activities that use vessels and in-water devices would occur year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Vessels have no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b). For example, testing activities that use vessels and in-water devices will not impact the prey species found in *Sargassum* habitat or the nearshore habitat conditions that are essential for nearshore reproductive habitat.

Pursuant to the ESA, the use of vessels and in-water devices during testing activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and would have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA in that regard.

3.8.3.4.1.2 Impacts from Vessels and In-Water Devices under Alternative 2

Impacts from Vessels and In-Water Devices under Alternative 2 for Training Activities

As shown in Tables 3.0-18–3.0-20 the locations of offshore training activities that use vessels are the same under Alternatives 1 and 2. However, the number of offshore training activities involving vessel movement would increase by approximately 2 percent annually and 3 percent over five years under Alternative 2. Similarly, the locations and annual numbers of training activities that include vessels within inshore waters of the AFTT Study Area would be the same under Alternatives 1 and 2. Even with the nominal increase in training activity levels described above, Navy training activities would remain consistent with the levels of activity and types activities undertaken in the AFTT Study Area over the last decade.

Similarly, Tables 3.0-22 and 3.0-23 show the locations of training activities within both offshore and inshore waters of the Study Area that use in-water devices area would be the same under Alternatives 1 and 2. In addition, the annual number of training activities occurring within inshore waters of the AFTT Study Area are identical between Alternatives 1 and 2. However, the number of offshore training activities that use in-water devices would increase by approximately 5 percent annually and 6 percent over five years (as with Alternative 1). This level of increased in-water device use would not appreciably change the potential for physical disturbance or strike of a sea turtle. Because the increase in activities under Alternative 2 over five years would be the same as with Alternative 1, impacts from training activities involving vessels and in-water devices under Alternative 2 would be similar to Alternative 1. Therefore, the analyses presented in Section 3.8.3.4.1.1 (Impacts from Vessels and In-Water Devices under Alternative 1) for training activities are applicable to training activities under Alternative 2.

Any collision with a sea turtle would result in injury, and possible mortality, of an individual sea turtle. Under Alternative 2 training activities, the Navy will continue to implement procedural mitigation to avoid or reduce the potential for vessel and in-water device strike of sea turtles (see Section 5.3.4.1, Vessel Movement, and Section 5.3.4.2, Towed In-Water Devices). Within a mitigation zone of a vessel or in-water device, trained observers will relay sea turtle locations to the operators, who are required to change course (no course change would be implemented if the vessel's safety is threatened, the vessel is restricted in its ability to maneuver (e.g., during launching and recovery of aircraft or landing craft, during towing activities, when mooring, etc.), or if the in-water device is operated autonomously. A mitigation zone size is not specified for sea turtles to allow flexibility based on vessel type and mission requirements (e.g., small boats operating in a narrow harbor).

Strike potential in inshore training locations for American alligators under Alternative 2 training activities would likely range from minor survivable injuries to death of individual alligators. Based on avoidance behaviors, as shown in open water locations with motorized and non-motorized boat traffic, strike potential is likely reduced. Potential impacts of exposure to vessels and in-water devices may result in substantial changes in an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment. Given the number of high-speed vessel hours in the inshore water locations, and the density of alligators in training locations, the possibility of a strike to an individual alligator cannot be discounted. Any strike at high speed is likely to result in significant injury. Potential impacts of exposure to vessels are not expected to result in population-level impacts for American alligators.

Strike potential in inshore training locations for the diamondback terrapin under Alternative 2 training activities would likely range from major injuries (because of the relatively small body mass and body type of terrapins) and death. Boat strikes are a significant concern in terrapin conservation efforts (Lester et al., 2012; Lester, 2013). Potential impacts of exposure to vessels and in-water devices may result in substantial changes in an individual terrapin's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment. Given the number of high-speed vessel hours in the inshore water locations, and the density of terrapins in training locations, the possibility of a strike to an individual terrapin cannot be discounted. Any strike at high speed is likely to result in significant injury. Potential impacts of exposure to vessels are not expected to result in population-level impacts for diamondback terrapins.

The leatherback turtle is likely to be impacted by training activities that use vessels and in-water devices, given its preference for open-ocean habitats and its feeding behavior (feed at the surface and throughout the water column) and prey (e.g., jellyfish). Hatchlings and pre-recruitment juveniles of all sea turtle species may also occur in open-ocean habitats, where they reside among *Sargassum* mats. Sea turtles are expected to be highly dispersed in deeper offshore waters; given the large area over which

Navy vessels could potentially conduct training activities, the likelihood of co-occurrence is low, as well as the potential consequences.

Proposed training activities under Alternative 2 that use vessels and in-water devices would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy training activities that use vessels and in-water devices would occur year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Vessels have no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b). For example, training activities that use vessels and in-water devices will not impact the prey species found in *Sargassum* habitat or the nearshore habitat conditions that are essential for nearshore reproductive habitat.

Pursuant to the ESA, the use of vessels and in-water devices during training activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and would have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat.

Impacts from Vessels and In-Water Devices under Alternative 2 for Testing Activities

As shown in Tables 3.0-18 through 3.0-20, the locations of testing activities within offshore and inshore waters that involve vessel movement would be the same under Alternatives 1 and 2. In addition, the annual and five-year numbers of testing activities that involve vessel movements within inshore waters of the AFTT Study Area are identical under Alternatives 1 and 2. However, the number of offshore testing activities would increase by 0.3 percent annually and by approximately 7 percent over five years. As previously indicated the number of testing activities that involve vessels are much lower than the number of training activities. Furthermore, testing activities may be conducted simultaneously with a training event, using a training vessel. The proposed increase in offshore vessel use from testing activities under Alternative 2 would still be consistent with the levels of activity and types activities undertaken in the AFTT Study Area over the last decade.

In addition, Tables 3.0-22 and 3.0-23 show the locations and annual numbers of testing activities that use in-water devices are the same under Alternatives 1 and 2. However, the number of testing activities that use in-water devices would increase approximately 11 percent over five years. This slight level of increased use of in-water devices does not substantially change the potential for physical disturbance or strike of sea turtles, crocodilians, or terrapins. Therefore, impacts from testing activities involving vessels and in-water devices under Alternative 2 would be similar to Alternative 1 and the analyses presented in Section 3.8.3.4.1.1 (Impacts from Vessels and In-Water Devices under Alternative 1) for testing activities are applicable to testing activities under Alternative 2.

Any collision with a sea turtle would result in injury, and possible mortality, of an individual sea turtle. Under Alternative 2 testing activities, the Navy will continue to implement procedural mitigation to avoid or reduce the potential for vessel and in-water device strike of sea turtles (see Section 5.3.4.1, Vessel Movement, and Section 5.3.4.2, Towed In-Water Devices). Within a mitigation zone of a vessel or in-water device, trained observers will relay sea turtle locations to the operators, who are required to change course (no course change would be implemented if the vessel's safety is threatened, the vessel is restricted in its ability to maneuver (e.g., during launching and recovery of aircraft or landing craft, during towing activities, when mooring, etc.), or if the in-water device is operated autonomously. A mitigation zone size is not specified for sea turtles to allow flexibility based on vessel type and mission requirements (e.g., small boats operating in a narrow harbor).

Strike potential in inshore testing locations for American alligators under Alternative 2 testing activities would likely range from minor survivable injuries to death of individual alligators. Based on avoidance behaviors, as shown in open-water locations with motorized and non-motorized boat traffic, strike potential is likely reduced. Potential impacts of exposure to vessels and in-water devices may result in substantial changes in an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment. Given the number of testing activities involving vessel movement in inshore locations, the possibility of a strike to an individual alligator cannot be discounted. Any strike at high speed is likely to result in significant injury. Potential impacts of exposure to vessels are not expected to result in population-level impacts for American alligators.

Strike potential in inshore testing locations for the diamondback terrapin under Alternative 2 testing activities would likely range from major injuries (because of the relatively small body mass and body type of terrapins) and death. Boat strikes are a significant concern in terrapin conservation efforts (Lester et al., 2012; Lester, 2013). Potential impacts of exposure to vessels and in-water devices may result in substantial changes in an individual terrapin's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment. Given the number of testing activities involving vessel movement in inshore locations, and the density of terrapins in testing locations, the possibility of a strike to an individual terrapin cannot be discounted. Any strike at high speed is likely to result in significant injury. Potential impacts of exposure to vessels are not expected to result in population-level impacts for the diamondback terrapin.

The leatherback turtle is likely to be impacted by testing activities that use vessels and in-water devices, given its preference for open-ocean habitats and its feeding behavior (feed at the surface and throughout the water column) and prey (e.g., jellyfish). Hatchlings and pre-recruitment juveniles of all sea turtle species may also occur in open-ocean habitats, where they reside among *Sargassum* mats. Sea turtles are expected to be highly dispersed in deeper offshore waters; given the large area over which Navy vessels could potentially conduct testing activities, the likelihood of co-occurrence is low, as well as the potential consequences.

Navy testing activities that use vessels and in-water devices would occur year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Vessels have no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b). For example, testing activities that use vessels and in-water devices will not impact the prey species found in *Sargassum* habitat or the nearshore habitat conditions that are essential for nearshore reproductive habitat.

Pursuant to the ESA, the use of vessels and in-water devices during testing activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and would have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat.

3.8.3.4.1.3 Impacts from Vessels and In-Water Devices under the No Action Alternative

Impacts from Vessels and In-Water Devices under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various physical disturbance and strike stressors (e.g., vessels and in-water devices) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.8.3.4.2 Impacts from Aircraft and Aerial Targets

Impacts from aircraft and aerial targets are not applicable to sea turtles, crocodilians, or terrapins because they do not occur in airborne environments and will not be analyzed further in this section. Refer to the Impacts from Military Expended Materials section (Section 3.8.3.4.3) for impacts from target fragments and the Acoustic Stressors section (Section 3.8.3.1) for potential disturbance from aircraft.

3.8.3.4.3 Impacts from Military Expended Materials

This section analyzes the strike potential to sea turtles from the following categories of military expended materials: (1) all sizes of non-explosive practice munitions; (2) fragments from high-explosive munitions; (3) expendable targets; and (4) expended materials other than munitions, such as sonobuoys, expended bathythermographs, and torpedo accessories.

For a discussion of the types of activities that use military expended materials refer to Appendix B (Activity Stressor Matrices) and for a discussion on where they are used and how much of each material is expended under each alternative, see Section 3.0.3.3.4.2 (Military Expended Materials). As described in Appendix F (Military Expended Materials and Direct Strike Impact Analyses), for physical disturbance and strike stressors as it relates to sea turtles, impacts from fragments from high-explosive munitions are included in the analysis presented in Section 3.8.3.2 (Explosive Stressors), and are not considered further in this section. These activities would occur in offshore and inshore training and testing locations that overlap with all species of sea turtles, American alligators, and diamondback terrapins. Because military expended materials would not be used in areas that overlap with the American crocodile known range or critical habitat designated for this species, the American crocodile is not analyzed for potential impacts from military expended materials.

The primary concern is the potential for a sea turtle, American alligator, or diamondback terrapin to be struck with a military expended material at or near the water's surface, which could result in injury or death. For sea turtles, although disturbance or strike from an item as it falls through the water column is possible, it is not likely because the objects generally sink through the water slowly and can be avoided by most sea turtles. Materials will slow in their velocity as they approach the bottom of the water and will likely be avoided by any juvenile or adult sea turtles (e.g., Kemp's ridley, green, loggerhead, or hawksbill turtles) that happen to be in the vicinity foraging in benthic habitats. Therefore, the discussion of military expended materials strikes focuses on the potential of a strike at the surface of the water. Other reptiles (such as American alligators and terrapins) could be on the water's surface. However, these reptiles may respond to other types of stressors (e.g., vessel noise or visual disturbance) and flee the vicinity of the inshore activity, thereby reducing the potential for physical disturbance and strike. Where inshore training and testing activities are adjacent to any terrapin rookery locations, terrapins (nesting females and hatchlings) may be at higher risk of physical disturbance and strike because more individual terrapins would be expected to occur in inshore waters in close proximity to these locations.

American alligators are likely sensitive to approaching vessels, often demonstrating avoidance behaviors to both motorized and non-motorized recreational boating in lakes (Lewis et al., 2014), and are likely at higher risk for strike in narrow shallow channels that would restrict the movements of a fleeing alligator. It is unlikely that military expended materials would strike American alligators in these waters because materials would not be expended in small creeks and similar habitats. American alligators would be at higher risk for strike in more relatively open waters like rivers and estuaries where materials may be expended.

Diamondback terrapins likely detect approaching vessels, but do not typically exhibit avoidance behaviors (Lester et al., 2012; Lester, 2013); therefore, terrapins are likely at increased strike risk by military expended materials when transiting an open water area or foraging at the surface.

While no strike from military expended materials has ever been reported or recorded on a reptile, the possibility of a strike still exists. Therefore, the potential for sea turtles to be struck by military expended materials was evaluated using statistical probability modeling to estimate potential direct strike exposures to a sea turtle. American alligators and diamondback terrapins were not included in the model because these species occur in relatively more shallow water habitats and would likely respond to other stressors from inshore training and testing activities. To estimate potential direct strike exposures of sea turtles, a scenario was calculated using the sea turtle species with the highest average monthly density in areas with the highest amounts of military expended material expenditures, specifically Virginia Capes and Jacksonville Range Complexes (see Appendix F, Military Expended Materials and Direct Strike Impact Analyses). Input values include munitions data (frequency, footprint and type), size of the training or testing area, sea turtle density data, and size of the animal. To estimate the potential of military expended materials to strike a sea turtle, the impact area of all military expended materials was totaled over one year in the area with the highest combined amounts of military expended materials for the Proposed Action. Loggerhead turtles are used as a proxy for modeling impacts because this species has the highest seasonal density within these two areas; therefore, loggerhead turtles provide the most conservative estimate of potential strikes. For estimates of expended materials in all areas, see Section 3.0.3.3.4.2 (Military Expended Materials). The analysis of the potential for a sea turtle strike is influenced by the following assumptions:

- The model is two-dimensional, assumes that all sea turtles would be at or near the surface 100 percent of the time, and does not consider any time a sea turtle would be submerged.
- The model also does not take into account the fact that most of the projectiles fired during training and testing activities are fired at targets, and that most projectiles hit those targets, so only a very small portion of those would hit the water with their maximum velocity and force.
- The model assumes the animal is stationary and does not account for any movement of the sea turtle or any potential avoidance of the training or testing activity.

The potential of fragments from high-explosive munitions or expended material other than munitions to strike a sea turtle is likely lower than for the worst-case scenario calculated above because those events happen with much lower frequency. Fragments may include metallic fragments from the exploded target, as well as from the exploded munitions.

There is a possibility that an individual turtle at or near the surface may be struck if they are in the target area at the point of physical impact at the time of non-explosive munitions delivery. Expended munitions may strike the water surface with sufficient force to cause injury or mortality. Direct munitions strikes from non-explosive bombs, missiles, and rockets are potential stressors to some species. Some individuals at or near the surface may be struck directly if they are at the point of impact at the time of non-explosive practice munitions delivery. However, most missiles hit their target or are disabled before hitting the water. Thus, most of these missiles and aerial targets hit the water as fragments, which quickly dissipates their kinetic energy within a short distance of the surface.

Adult sea turtles are generally at the surface for short periods and spend most of their time submerged; however, hatchlings and juveniles of all sea turtle species spend more time at the surface while in ocean currents, and all sea turtle life stages bask on the surface. Leatherback sea turtles of all age classes are more likely to be foraging at or near the surface in the open ocean than other species, but the likelihood of being struck by a projectile remains very low because of the wide spatial distribution of leatherbacks relative to the point location of an activity. Furthermore, projectiles are aimed at targets, which will absorb the impact of the projectile. Other factors that further reduce the likelihood of a sea turtle being struck by an expended munition include the recovery of all non-explosive torpedoes as well as target-related materials that are intact after the activity. The Navy will implement mitigation (e.g., not conducting gunnery activities against a surface target when a specified distance from sea turtles) to avoid potential impacts from military expended materials on sea turtles throughout the Study Area (see Section 5.3, Procedural Mitigation to be Implemented).

3.8.3.4.3.1 Impacts from Military Expended Materials under Alternative 1

Impacts from Military Expended Materials under Alternative 1 for Training Activities

Training activities in offshore waters under Alternative 1 that involve military expended materials under the Proposed Action would occur in the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, Gulf of Mexico Range Complexes, and other AFTT areas. In addition, training activities that involve military expended materials would be conducted within inshore waters within and around Boston, Massachusetts; Earle, New Jersey; Delaware Bay, Delaware; Narragansett, Rhode Island; Hampton Roads, Virginia; James River and tributaries, Virginia; the Lower Chesapeake Bay, Virginia; Morehead City, North Carolina; Wilmington, North Carolina; Cooper River, South Carolina; Savannah, Georgia; Kings Bay, Georgia; Mayport, Florida; Port Canaveral, Florida; Tampa, Florida; Beaumont, Texas; and Corpus Christi, Texas (see Table 3.0-30 and Table 3.0-33). Navy training activities have the potential to expose all age classes of any species of sea turtle within these offshore and inshore areas to military expended materials.

Sea turtles are expected to be highly dispersed in offshore waters. Repeated exposures to sea turtles are not anticipated as these offshore areas do not have resident animals year round. Navy training activities involving military expended materials in the inshore waters occur in several locations along the Atlantic coast, but fewer types of military materials would be expended compared to the activities in the offshore areas (see Section 3.0.3.3.4.2, Military Expended Materials). For training activities occurring in inshore waters, loggerhead, green, Kemp's ridley, and hawksbill turtles that have recruited to benthic foraging grounds could be present. Leatherbacks that forage at the surface in coastal and sometimes estuarine waters would also be present. Hatchlings of all sea turtle species would be present very briefly as they leave the nest, enter the water, and move to offshore areas to develop. Hatchlings would only be present a few months of the year between summer and fall from southern Virginia and further south.

As stated previously, factors that further reduce the likelihood of a sea turtle being struck by an expended munition include the recovery of all non-explosive torpedoes as well as target-related materials that are intact after the activity. The Navy will implement mitigation (e.g., not conducting gunnery activities against a surface target when a specified distance from sea turtles) to avoid potential impacts from military expended materials on sea turtles throughout the Study Area. Hatchlings and pre-recruitment juveniles of all sea turtle species may also occur in open-ocean habitats; however, the likelihood of impact is lower for these age classes due to their occurrence at or near the water surface by concentrated *Sargassum* mats. Activities will not be initiated near concentrated Sargassum mats due to the possible presence of sea turtles (see Section 5.3, Procedural Mitigation to be Implemented).

American alligators and diamondback terrapins would also be exposed to training activities using military expended materials in inshore locations. Under Alternative 1, American alligators may be potentially exposed to military expended materials in inshore locations in North Carolina, South Carolina, Georgia, Florida, and Texas, while diamondback terrapins may be exposed in all inshore training locations. The likelihood of a physical disturbance and strike of an American alligator and diamondback terrapin is low because of the relatively lower numbers of military expended materials that would be expended in inshore waters compared to offshore locations, and the anticipated lower density of alligators and terrapins in inshore training locations. However, because of the potential for larger concentrations of female adult terrapins at coastal rookery locations at the beginning of nesting season and the larger concentration of hatchlings in waters at the end of nesting season, terrapins are at higher risk of physical disturbance and strike of military expended materials.

The model results presented in Appendix F (Military Expended Materials and Direct Strike Impact Analyses) estimate loggerhead sea turtle exposures (as discussed above, as a conservative proxy for all sea turtles) during training activities in the Virginia Capes and Jacksonville Range Complexes. The loggerhead turtle was used as a proxy for all sea turtle species because this species has the highest offshore density estimates, which would provide the most conservative output results. Based on a worst-case scenario, the results indicate with a reasonable level of certainty that sea turtles would not be struck by non-explosive practice munitions and expended materials other than munitions. In the Virginia Capes Range Complex, the model estimates approximately 0.08 direct strike exposures per year. In the Jacksonville Range Complex, the model estimates 0.03 direct strike exposures per year. As stated previously, for the purposes of modeling, only Virginia Capes and Jacksonville Range Complexes were used because these two training areas would have the highest estimated numbers and concentrations of military expended materials for each alternative and would thus provide a reasonable comparison for all other areas with fewer expended materials.

Green, Kemp's ridley, and loggerhead sea turtles may occur in these areas used for modeling (Virginia Capes and Jacksonville Range Complexes). Hawksbill turtles may also occur in the Jacksonville Range Complex and farther south off the U.S. Atlantic and Gulf coasts, but less frequently than the other species of sea turtles. Leatherback turtles are more likely to be farther offshore, in the open ocean, although in the summer they are known to forage in nearshore environments in inshore waters of Virginia and North Carolina. Military expended materials deposition would be less concentrated in the Gulf of Mexico because of fewer activities that would expend materials. All of these sea turtle species may occur within the Gulf of Mexico, but Kemp's ridley and green sea turtles are more abundant.

Under Alternative 1, training activities could introduce exposure risk to military expended materials, but activities are not expected to result in substantial changes in an individual reptile's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment, and as such are not expected to result in population-level impacts for all sea turtle species.

Proposed training activities under Alternative 1 that use military expended materials would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy training activities that use military expended materials would occur year round within the five critical habitat types for the loggerhead sea turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Military expended materials use has no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to some of the military expended materials being recovered or sinking through the water column. Military expended materials would not be expended in the water to the point where migratory corridors would be obstructed and would not degrade nearshore reproductive habitat, winter areas, breeding areas, or *Sargassum* habitat.

Pursuant to the ESA, activities that use military expended materials during training activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Military Expended Materials under Alternative 1 for Testing Activities

Testing activities in offshore waters that involve military expended materials under the Proposed Action would primarily occur in the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West and Gulf of Mexico Range Complexes within the Study Area. Other areas include the Naval Undersea Warfare Center, Newport Testing Range; the South Florida Ocean Measurement Facility Testing Range; and Naval Surface Warfare Center, Panama City Testing Range (see Table 3.0-26, Table 3.0-28, Table 3.0-31, and Table 3.0-34). It should be noted that military expended materials would not be expended in inshore waters; therefore, American crocodiles, American alligators, and diamondback terrapins are not analyzed for potential impacts from Alternative 1 testing activities.

Sea turtles are expected to be highly dispersed in offshore waters. Repeated exposures to sea turtles are not anticipated as these offshore areas do not have resident animals year round. The results presented in Appendix F (Military Expended Materials and Direct Strike Impact Analyses) indicate a reasonable level of certainty that no sea turtles would be struck by military expended materials. Based on a worst-case scenario, the results indicate with a reasonable level of certainty that sea turtles would not be struck by non-explosive practice munitions and expended materials other than munitions. In the Virginia Capes Range Complex, the model estimates approximately 0.03 direct strike exposures per year. In the Jacksonville Range Complex, the model estimates 0.06 direct strike exposures per year. As mentioned previously, the loggerhead turtle was used as a proxy for all sea turtle species because this species has the highest offshore density estimates, which would provide the most conservative modeling output results. In addition, Virginia Capes Range Complex and Jacksonville Range Complex were the only areas modeled because these two areas would have the highest concentration of military expended materials from testing activities, again providing the most conservative modeling output results.

Under Alternative 1, testing activities will introduce exposure risk to military expended materials, which could result in changes to a sea turtle's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment. No impacts to individual sea turtles are expected; therefore, no population-level effects would result from testing activities under Alternative 1.

As with training activities, factors that further reduce the likelihood of a sea turtle being struck by an expended munition include the recovery of all non-explosive torpedoes as well as target-related materials that are intact after the activity. The Navy will implement mitigation (e.g., not conducting gunnery activities against a surface target when a specified distance from sea turtles) to avoid potential impacts from military expended materials on sea turtles throughout the Study Area. Hatchlings and pre-recruitment juveniles of all sea turtle species may also occur in open-ocean habitats; however, the likelihood of impact is lower for these age classes due to their occurrence at or near the water surface by concentrated *Sargassum* mats. Activities will not be initiated near concentrated Sargassum mats due to the possible presence of sea turtles (see Section 5.3, Procedural Mitigation to be Implemented).

Under Alternative 1 testing activities, release of military expended materials would not occur in critical habitat designations for the American Crocodile (Florida Bay), green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), or leatherback sea turtle (St. Croix Island). Navy testing activities that use military expended materials would occur year round within the five critical habitat types for the loggerhead sea turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Military expended materials use has no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to some of the military expended materials being recovered or sinking through the water column. Military expended materials would not be expended in the water to the point where migratory corridors would be obstructed and would not degrade nearshore reproductive habitat, winter areas, breeding areas, or *Sargassum* habitat.

Pursuant to the ESA, activities that use military expended materials during testing activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and would have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA in that regard.

3.8.3.4.3.2 Impacts from Military Expended Materials under Alternative 2

Impacts from Military Expended Materials under Alternative 2 for Training Activities

Although there is a slight increase in the numbers of military expended materials released during training activities under Alternative 2 relative to Alternative 1, probability analyses conducted for training activities under Alternative 2 yielded nearly identical exposures compared to Alternative 1. Based on a worst-case scenario, the results indicate with a reasonable level of certainty that sea turtles would not be struck by non-explosive practice munitions and expended materials other than munitions. In the Virginia Capes Range Complex, the model estimates approximately 0.066 exposures per year. In the Jacksonville Range Complex, the model estimates 0.040 strikes per year. These results provide a high level of certainty that no sea turtles would be struck by military expended materials under Alternative 2 training activities. Hatchlings and pre-recruitment juveniles of all sea turtle species may also occur in open-ocean habitats; however, the likelihood of impact is lower for these age classes due to their occurrence at or near the water surface by concentrated *Sargassum* mats. Activities will not be initiated near concentrated Sargassum mats due to the possible presence of sea turtles (see Section 5.3, Procedural Mitigation to be Implemented). In addition, the results indicate that fractional increases in expendable targets and expended materials other than munitions proposed under Alternative 2 does not substantially increase the potential for direct strike to sea turtles. Therefore, the associated impacts on sea turtles are expected to be identical to Alternative 1 as presented in Section 3.8.3.4.3.1 (Impacts from Military Expended Materials under Alternative 1) for training activities.

As with Alternative 1, American alligators and diamondback terrapins would also be exposed to training activities using military expended materials in inshore locations. Under Alternative 2, American alligators may be potentially exposed to military expended materials in inshore locations in North Carolina, South Carolina, Georgia, Florida, and Texas, while diamondback terrapins may be exposed in all inshore training locations. The likelihood of a physical disturbance and strike of an American alligator and diamondback terrapin is low because of the relatively lower numbers of military expended materials that would be expended in inshore waters compared to offshore locations, and the anticipated lower density of alligators and terrapins in inshore training locations. However, because of the potential for larger concentrations of female adult terrapins at coastal rookery locations at the beginning of nesting season and the larger concentration of hatchlings in waters at the end of nesting season, terrapins are at higher risk of physical disturbance and strike of military expended materials.

Proposed training activities under Alternative 2 that use military expended materials would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy training activities that use military expended materials would occur year round within the five critical habitat types for the loggerhead sea turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Military expended materials use has no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to some of the military expended materials being recovered or sinking through the water column. Military expended materials would not be expended in the water to the point where migratory corridors would be obstructed and would not degrade nearshore reproductive habitat, winter areas, breeding areas, or *Sargassum* habitat.

Pursuant to the ESA, activities that use military expended materials during training activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and would have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat.

Impacts from Military Expended Materials under Alternative 2 for Testing Activities

Although there is a slight increase in the numbers of military expended materials released during testing activities under Alternative 2 relative to Alternative 1, probability analyses conducted for testing activities under Alternative 2 yielded nearly identical exposures compared to Alternative 1. Based on a worst-case scenario, the results indicate with a reasonable level of certainty that sea turtles would not be struck by non-explosive practice munitions and expended materials other than munitions. In the Virginia Capes Range Complex, the model estimates approximately 0.025 exposures per year. In the Jacksonville Range Complex, the model estimates 0.068 strikes per year. These results provide a high level of certainty that no sea turtles would be struck by military expended materials under Alternative 2 training activities. In addition, the results indicate that fractional increases in expendable targets and expended materials other than munitions proposed under Alternative 2 does not substantially increase the potential for direct strike to sea turtles. Hatchlings and pre-recruitment juveniles of all sea turtle species may also occur in open-ocean habitats; however, the likelihood of impact is lower for these age classes due to their occurrence at or near the water surface by concentrated *Sargassum* mats. Activities will not be initiated near concentrated Sargassum mats due to the possible presence of sea turtles (see Section 5.3, Procedural Mitigation to be Implemented). Therefore, the associated impacts on sea turtles are expected to be identical to Alternative 1 as presented in Section 3.8.3.4.3.1 (Impacts from Military Expended Materials under Alternative 1) for testing activities.

As with Alternative 1, testing activities under Alternative 2 that would use military expended materials would not occur in inshore waters; therefore, American crocodiles, American alligators, and diamondback terrapins are not analyzed for potential impacts from Alternative 2 testing activities.

Proposed testing activities under Alternative 2 that use military expended materials would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy testing activities that use military expended materials would occur year round within the five critical habitat types for the loggerhead sea turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Military expended materials use has no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to some of the military expended materials being recovered or sinking through the water column. Military expended materials would not be expended in the water to the point where migratory corridors would be obstructed and would not degrade nearshore reproductive habitat, winter areas, breeding areas, or *Sargassum* habitat.

Pursuant to the ESA, activities that use military expended materials during testing activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and would have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat.

3.8.3.4.3.3 Impacts from Military Expended Materials under the No Action Alternative

Impacts from Military Expended Materials under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the proposed training or testing activities in the AFTT Study Area. Various physical disturbance and strike stressors (e.g., military expended materials) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.8.3.4.4 Impacts from Seafloor Devices

For a discussion of the types of activities that use seafloor devices refer to Appendix B (Activity Stressor Matrices) and for a discussion on where they are used and how many exercises would occur under each alternative, see Section 3.0.3.3.4.3 (Seafloor Devices). These include items placed on, dropped on or moved along the seafloor such as mine shapes, anchor blocks, anchors, bottom-placed instruments, and bottom-crawling unmanned underwater vehicles. The likelihood of any reptile species encountering seafloor devices is considered low because these items are either stationary or move very slowly along the bottom.

Benthic-foraging sea turtles (e.g., Kemp's ridley, green, loggerhead, or hawksbill turtles), American alligators, and diamondback terrapins would most likely encounter a seafloor device, but would likely avoid it. In the unlikely event that a reptile is in the vicinity of a seafloor device, the slow movement and stationary characteristics of these devices would not be expected to physically disturb or alter natural behaviors of sea turtles, alligators, or terrapins. As discussed in Section 3.8.3.4.3 (Impacts from Military Expended Materials), objects fall through the water slowly until they rest on the seafloor and could be avoided by most reptiles. Therefore, these items do not pose a significant strike risk to sea turtles, terrapins, or alligators. The only seafloor device used during training and testing activities that has the potential to strike a reptile at or near the surface is an aircraft deployed mine shape, which is used during aerial mine laying activities. These devices are identical to non-explosive practice bombs, therefore the analysis of the potential impacts from those devices are covered in Section 3.8.3.4.3 (Impacts from Military Expended Materials) and are not further analyzed in this section.

All of the inshore training locations shown in Table 3.0-36 may potentially be inhabited by diamondback terrapins, while inshore training locations in North Carolina, South Carolina, Georgia, Florida, and Texas may be inhabited by the American alligator. Seafloor devices would not be used in American crocodile habitats or within critical habitat designated for this species; therefore, American crocodiles are not discussed further in the analysis for potential impacts of the use of seafloor devices.

3.8.3.4.4.1 Impacts from Seafloor Devices under Alternative 1

Impacts from Seafloor Devices under Alternative 1 for Training Activities

Offshore training activities that use seafloor devices under Alternative 1 would primarily occur in the Virginia Capes Range Complex. Other locations include Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes; and the Naval Surface Warfare Center, Panama City Testing Range (see Table 3.0-35). In addition training activities that use seafloor devices would be conducted within inshore waters including and surrounding Boston, Massachusetts; Earle, New Jersey; Delaware Bay, Delaware; Hampton Roads, Virginia, the Lower Chesapeake Bay, Virginia; James River and tributaries, Virginia; York River, Virginia; Morehead City, North Carolina; Wilmington, North Carolina; Savannah, Georgia; Kings Bay, Georgia; Mayport, Florida; Port Canaveral, Florida; Truman Harbor, Florida; Demolition Key, Florida; Tampa Florida; Beaumont, Texas; and Corpus Christi, Texas (see Table 3.0-36).

For training activities occurring in the offshore waters, loggerhead, green, and hawksbill turtles may be impacted, especially if seafloor devices are expended in waters where the isobaths are not greater than the benthic foraging ability (dive depth). Adult loggerhead turtles may be found foraging in waters as deep as 200 m (Hochscheid, 2014). Juvenile sea turtles (e.g., green turtles) may rest and forage in waters as deep as approximately 30 m (Hochscheid, 2014), and hawksbill turtles have a recorded maximum dive depth of about 80 m. Leatherback turtles are more likely to co-occur with these offshore activities given their preference for open-ocean habitats and its feeding behavior (feed throughout the water column); therefore, this species may be exposed to a seafloor device as it is being deployed to the bottom. For example, leatherbacks may dive to depths greater than 1,000 m in search of prey (e.g., jellyfish) (Hochscheid, 2014). Animals are expected to be highly dispersed in offshore waters. Repeated exposures to animals are not anticipated as these offshore areas do not have resident sea turtles year round.

Navy training activities involving seafloor devices in the inshore waters occur in several locations along the Atlantic coast, but fewer estimated annual activities involving seafloor devices would be conducted compared to the activities in the offshore areas. The most training events involving seafloor devices would be conducted in the Lower Chesapeake Bay. Other locations include the James River and

Tributaries, Virginia; and Narragansett, Rhode Island. For training activities occurring in inshore waters, juvenile, sub-adult, and adult loggerhead, green, Kemp's ridley, and to a lesser extent hawksbill sea turtles that have recruited to benthic foraging grounds would most likely be impacted. Sub-adult and adult leatherbacks that forage at the surface in coastal and sometimes estuarine waters would also be present. Based on the analysis in Section 3.8.3.4.3 (Impacts from Military Expended Materials), there is a reasonable level of certainty that no sea turtles would be struck by seafloor devices. The likelihood of a sea turtle encountering seafloor devices in benthic foraging habitats is considered low because these items are either stationary or move very slowly along the bottom. Seafloor devices are not likely to interfere with sea turtles resident to coastal or inshore waters, or engaging in migratory, reproductive, and feeding behaviors within the range complexes of the AFTT Study Area. Further, seafloor devices would mostly impact sea turtle species that are foraging in benthic habitats (e.g., Kemp's ridley, loggerhead, hawksbill, and green sea turtles) or throughout the water column in deep waters (e.g., leatherback sea turtle). Additionally, some sea turtle species in coastal habitats can occur near the bottom resting. Sea turtles encountering seafloor devices would likely avoid them because of the devices' slow movement and visibility. Given the slow movement of seafloor devices, the effort expended by sea turtles to avoid them would be minimal, and any behavioral impacts would be temporary.

American alligators may encounter seafloor devices in inshore training locations in Morehead City, North Carolina; Wilmington, North Carolina; Savannah, Georgia; Kings Bay, Georgia; Mayport, Florida; Port Canaveral, Florida; Truman Harbor, Florida; Demolition Key, Florida; Tampa Florida; Beaumont, Texas; and Corpus Christi, Texas. American alligators can spend extended periods of time under water (as much as 40 percent of the time during nighttime foraging activities, Nifong [2014]). During this submerged time, the potential for alligators to be struck by seafloor devices is low, as alligators would likely avoid seafloor devices due to their slow movement and visibility and because they do not resemble prey items. Given the slow movement of seafloor devices, the effort expended by alligators to avoid them would be minimal, and any behavioral impacts would be temporary.

Diamondback terrapins may encounter seafloor devices in all inshore training locations. Terrapins would likely be in estuarine benthic habitats foraging for prey items, such as shellfish (Hart & Lee, 2006; Pfau & Roosenburg, 2010). For the same reasons as for sea turtles and for alligators, terrapins would likely avoid and not be struck by seafloor devices, because these devices are slow moving and likely visible to diamondback terrapins in estuarine benthic habitats. Given the slow movement of seafloor devices, the effort expended by diamondback terrapins to avoid them would be minimal, and any behavioral impacts would be temporary.

Proposed training activities under Alternative 1 that use seafloor devices would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy training activities that use seafloor devices would occur year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Seafloor devices use has no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to the localized area potentially impacted by seafloor devices and the fact that most seafloor devices are recovered. Seafloor devices would not be expended in the water to the point where migratory corridors would be obstructed and would not degrade nearshore reproductive habitat, winter areas, breeding areas, or *Sargassum* habitat.

Pursuant to the ESA, training activities that use seafloor devices under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and would have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Seafloor Devices under Alternative 1 for Testing Activities

Testing activities that involve the use of seafloor devices under Alternative 1 would occur in the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes; Naval Undersea Warfare Center, Newport Testing Range; South Florida Ocean Measurement Facility Testing Range; Naval Surface Warfare Center, and Panama City Testing Range (see Table 3.0-35). In addition, testing activities that use seafloor devices would be conducted within the inshore waters surrounding Little Creek, Virginia and Norfolk, Virginia. For testing activities under Alternative 1, seafloor devices may be deployed in habitats used by sea turtles and diamondback terrapins. Inshore locations proposed for use under Alternative 1 testing activities do not include habitat areas for the American crocodile, critical habitat for the American crocodile, or American alligator habitats; therefore, crocodilian species are not analyzed for impacts under Alternative 1 testing activities.

For testing activities occurring in the offshore waters, the species and age classes that may be impacted are juvenile and adult loggerhead, green, and hawksbill sea turtles, especially if seafloor devices are expended in waters where the isobaths are not greater than the benthic foraging ability (dive depth). The loggerhead turtle is the most abundant species in the Virginia Capes Range Complex, and adults may be found foraging in waters as deep as 200 m (Hochscheid, 2014). Juvenile sea turtles (e.g., green turtles) may rest and forage in waters as deep as approximately 30 m (Hochscheid, 2014), and hawksbill turtles have a recorded maximum dive depth of about 80 m. Juvenile and adult leatherback turtles are more likely to co-occur with these offshore activities given their preference for open-ocean habitats and their feeding behavior (e.g., feed throughout the water column); therefore, this species may be exposed to a seafloor device as it is being deployed to the bottom. For example, leatherbacks may dive to depths greater than 1,000 m in search of prey (e.g., jellyfish) (Hochscheid, 2014). Animals are expected to be highly dispersed in offshore waters. Repeated exposures to animals are not anticipated as these offshore areas do not have resident sea turtles year round.

Navy testing activities involving seafloor devices in the inshore waters occur at two locations along the Atlantic coast; Little Creek, Virginia; and Norfolk, Virginia. Only one activity involving seafloor devices is estimated to occur per year at each location (see Section 3.0.3.3.4.3, Seafloor Devices). For testing activities occurring in inshore waters, juvenile, sub-adult, and adult loggerhead, green, and Kemp's ridley turtles that have recruited to benthic foraging grounds would most likely be impacted. Sub-adult and adult leatherbacks that forage at the surface in coastal and sometimes estuarine waters would also be present. Based on the analysis in Section 3.8.3.4.3 (Impacts from Military Expended Materials), there is a reasonable level of certainty that no sea turtles would be struck by seafloor devices. The likelihood of a sea turtle encountering seafloor devices in benthic foraging habitats is considered low because these items are either stationary or move very slowly along the bottom. Seafloor devices are not likely to interfere with sea turtles resident to coastal or inshore waters, or engaging in migratory, reproductive, and feeding behaviors within the range complexes of the AFTT Study Area. Further, seafloor devices would impact sea turtle species that are foraging in benthic habitats (e.g., Kemp's ridley, loggerhead, hawksbill, and green sea turtles) or throughout the water column in deep waters (e.g., leatherback sea turtle). Additionally, some sea turtle species in coastal habitats can occur near the bottom when resting.

Sea turtles encountering seafloor devices would likely avoid them because of their slow movement and visibility. Given the slow movement of seafloor devices, the effort expended by sea turtles to avoid them would be minimal, and behavioral impacts would be temporary.

Diamondback terrapins may encounter seafloor devices in the testing locations of Little Creek and Norfolk, Virginia. Terrapins would likely be in estuarine benthic habitats foraging for prey items, such as shellfish (Pfau & Roosenburg, 2010). For the same reasons as for sea turtles, terrapins would likely not be struck by and would avoid seafloor devices, which are slow moving and likely visible to diamondback terrapins in estuarine benthic habitats. Given the slow movement of seafloor devices, the effort expended by diamondback terrapins to avoid them would be minimal, and any behavioral impacts would be temporary.

Proposed testing activities under Alternative 1 that use military expended materials would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy testing activities that use seafloor devices would occur year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Seafloor devices use has no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to the localized area potentially impacted by seafloor devices and the fact that most seafloor devices are recovered. Seafloor devices would not be expended in the water to the point where migratory corridors would be obstructed and would not degrade nearshore reproductive habitat, winter areas, breeding areas, or *Sargassum* habitat.

Pursuant to the ESA, testing activities that use seafloor devices under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and would have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA in that regard.

3.8.3.4.4.2 Impacts from Seafloor Devices under Alternative 2

Impacts from Seafloor Devices under Alternative 2 for Training Activities

As stated in Section 3.0.3.3.4.3 (Seafloor Devices), the locations and annual number of training activities that involve seafloor devices are the same under Alternatives 1 and 2. Based on the analysis in Section 3.8.3.4.4.1 (Impacts from Seafloor Devices under Alternative 1) for training activities, there is a reasonable level of certainty that no reptiles would be struck by seafloor devices.

Proposed training activities under Alternative 2 that use military expended materials would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy training activities that use seafloor devices would occur year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Seafloor devices use has no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to the localized area potentially impacted by seafloor devices and the fact that most seafloor devices are recovered. Seafloor devices would not be expended in the water to the point where migratory corridors would be obstructed and would not degrade nearshore reproductive habitat, winter areas, breeding areas, or *Sargassum* habitat.

Pursuant to the ESA, training activities that use seafloor devices under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and would have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat.

<u>Impacts from Seafloor Devices under Alternative 2 for Testing Activities</u>

As stated in Section 3.0.3.3.4.3 (Seafloor Devices) the location of testing activities that use seafloor devices are the same under Alternatives 1 and 2; however, the number of testing activities proposed under Alternative 2 would increase by approximately 2 percent annually and by approximately 7 percent over five years. Based on the analysis in Section 3.8.3.4.3.2 (Impacts from Military Expended Materials under Alternative 2) for testing activities, there is a reasonable level of certainty that no reptiles would be struck by seafloor devices.

Proposed training activities under Alternative 2 that use military expended materials would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy training activities that use seafloor devices would occur year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Seafloor devices use has no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to the localized area potentially impacted by seafloor devices and the fact that most seafloor devices are recovered. Seafloor devices would not be expended in the water to the point where migratory corridors would be obstructed and would not degrade nearshore reproductive habitat, winter areas, breeding areas, or *Sargassum* habitat.

Pursuant to the ESA, testing activities that use seafloor devices under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and would have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat.

3.8.3.4.4.3 Impacts from Seafloor Devices under the No Action Alternative

<u>Impacts from Seafloor Devices under the No Action Alternative for Training and Testing Activities</u>

Under the No Action Alternative, the Navy would not conduct the proposed training or testing activities in the AFTT Study Area. Various physical disturbance and strike stressors (e.g., seafloor devices) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.8.3.4.5 Pile Driving

Pile driving occurs during training activities and would have no effect on reptiles because they are mobile and would be able to avoid the physical disturbance and strike stressors associated with pile driving activities. Pile driving would occur at two locations: Little Creek, Virginia; and Camp Lejeune, North Carolina. Pile driving would not occur during testing activities. This activity is analyzed under acoustic stressors (see Section 3.8.3.1.4, Impacts from Pile Driving) for potential impacts on reptiles (sea turtles, alligators, and diamondback terrapins).

Proposed training activities that involve pile driving would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), loggerhead sea turtle (breeding areas, nearshore reproductive habitat, winter areas, migration corridors, or *Sargassum* habitat), or American crocodile (Florida Bay).

Pursuant to the ESA, training activities that involve pile driving under Alternative 1 and Alternative 2 would have no effect on the ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and have no effect on the ESA-listed American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and there would be no effect on American crocodile critical habitat.

3.8.3.5 Entanglement Stressors

This section analyzes the potential entanglement impacts of the various types of expended materials used by the Navy during training and testing activities within the Study Area. This analysis includes the potential impacts from three types of military expended materials: (1) wires and cables (2) decelerators/parachutes and (3) biodegradable polymers. Because expended materials that present entanglement risk to sea turtles are not expended in crocodilian or terrapin habitats, and because it is reasonable to assume that military expended materials would not drift into crocodilian or terrapin habitats, entanglement stressors are not analyzed for potential impacts on the American crocodile, American alligator, or the diamondback terrapin.

These materials could be encountered by sea turtles and if encountered, may have the potential to entangle sea turtles in the AFTT Study Area at the surface, in the water column, or along the seafloor. The number and location of materials or activities that involve the use of items that may pose an entanglement risk are provided in Section 3.0.3.3.5 (Entanglement Stressors). General discussion of impacts can also be found in Section 3.0.3.6.4 (Conceptual Framework for Assessing Effects from Entanglement).

Risk factors for entanglement of sea turtles include animal size (and life stage), sensory capabilities, and foraging methods. Most entanglements discussed in the literature are attributable to sea turtle entrapments with fishing gear or other non-military materials that float or are suspended at the surface. Entanglement events are difficult to detect from land or from a boat as they may occur at considerable distances from shore and typically take place underwater. Juvenile turtles and hatchlings are inherently less likely to be detected than larger adult sea turtles. The likelihood of witnessing an entanglement event is therefore typically low. However, the properties and size of these military expended materials, as described in Section 3.0.3.3.5 (Entanglement Stressors) and Section 3.0.3.6.4 (Conceptual Framework for Assessing Effects from Entanglement), makes entanglement a possibility.

3.8.3.5.1 Impacts from Wires and Cables

For a discussion of the types of activities that use wires and cables see Appendix B (Activity Stressor Matrices). For a discussion on where they are used and how many wires and cables would be expended under each alternative, see Section 3.0.3.3.5.1 (Wires and Cables). A sea turtle that becomes entangled in nets, lines, ropes, or other foreign objects under water may suffer temporary hindrance to movement before it frees itself or may remain entangled. The turtle may suffer minor injuries but recover fully, or it may die as a result of the entanglement. The entanglement risk to sea turtles of these items are discussed below.

Some fiber optic cables used during Navy training and testing associated with remotely operated mine neutralization activities would be expended, although a portion may be recovered. The length of the expended tactical fiber would vary (up to about 3,000 m) depending on the activity. Tactical fiber has an 8-micrometer (0.008 mm) silica core and acylate coating, and looks and feels like thin monofilament fishing line. Other characteristics of tactical fiber are a 242-micrometer (0.24 mm) diameter, 12-lb. tensile strength, and 3.4-mm bend radius (Corning Incorporated, 2005; Raytheon Company, 2015). Tactical fiber is relatively brittle; it readily breaks if knotted, kinked, or abraded against a sharp object. Deployed tactical fiber breaks if it is looped beyond its bend radius (3.4 mm) or exceeds its tensile strength (12 lb.). If the fiber becomes looped around an underwater object or sea turtle, it does not tighten unless it is under tension. Such an event would be unlikely based on its method of deployment and its resistance to looping after it is expended. The tactical fibers are often designed with controlled buoyancy to minimize the fiber's effect on vehicle movement. The tactical fiber would be suspended within the water column during the activity, and then be expended and sink to the seafloor (effective sink rate of 1.45 cm/second [Raytheon, 2015]) where it would be susceptible to abrasion and burial by sedimentation. Additionally, encounter rates with fiber optic cables by sea turtles are limited by the small number of cables that are expended.

If the isobath is greater than the maximum benthic foraging ability (dive depth) of a sea turtle, then these cables would not present an entanglement risk. For example, as discussed previously, leatherbacks may dive to depths greater than 1,000 m in search of prey (e.g., jellyfish), while other species (e.g., loggerheads) may forage in benthic habitats as deep as approximately 200 m, and juvenile sea turtles (e.g., green sea turtles) resting and foraging in waters as deep as approximately 30 m (Hochscheid, 2014). In addition, although hatchlings would not likely be able to escape entrapment if entangled, but the chance of entanglement for a hatchling is very unlikely since these cables will be within the water column during the activity. Therefore, fiber optic cables present an entanglement risk to sea turtles, but it is unlikely that an entanglement event would occur and any entanglement would be temporary (a few seconds) before the sea turtle could resume normal activities. As noted in Section 3.8.2.1.5 (General Threats), entanglement by fishing gear is a serious global threat to sea turtles. The various types of marine debris attributed to sea turtle entanglement (e.g., commercial fishing gear, towed gear, stationary gear, or gillnets) have substantially higher (up to 500–2,000 lb.) breaking strengths at their "weak links." If fiber optic cables and fragments of cables sink to the seafloor in an area where the bottom is calm, they would remain there undisturbed. In an area with bottom currents or active tidal influence, the fiber optic strands may move along the seafloor, away from the location in which they were expended and potentially into sea turtle benthic foraging habitats. Over time, these strands may become covered by sediment in most areas or colonized by attaching and encrusting organisms, which would further stabilize the material and reduce the potential for reintroduction as an entanglement risk.

Similar to tactical fibers discussed above, guidance wires may pose an entanglement threat to sea turtles either in the water column or after the wire has settled to the seafloor. The Navy previously analyzed the potential for entanglement of sea turtles by guidance wires and concluded that the potential for entanglement is low (U.S. Department of the Navy, 1996). These conclusions have also been carried forward in NMFS analyses of Navy training and testing activities (National Marine Fisheries Service, 2013b). The likelihood of a sea turtle encountering and becoming entangled in a guidance wire depends on several factors. With the exception of a chance encounter with the guidance wire while it is sinking to the seafloor (at an estimated rate of 0.7 ft. per second), it is most likely that a sea turtle would only encounter a guidance wire once it had settled on the seafloor. Since the guidance wire will only be within the water column during the activity and while it sinks, the likelihood of a sea turtle encountering and becoming entangled within the water column is extremely low. The tensile breaking strength of the wire is a maximum of 40.4 lb. and can be broken by hand (Swope & McDonald, 2013) in contrast with the rope or lines associated with commercial fishing activities. However, it has a somewhat higher breaking strength than the monofilament used in the body of most commercial gillnets (typically 31 lb. or less). In addition, any undispensed wire would be contained in the dispensers upon impact of the sonobuoy or missile with the target. In addition, based on degradation times, the guidance wires would break down within one to two years and therefore no longer pose an entanglement risk. As with fiber optic cables, guidance wire fragments may move with bottom currents or active tidal influence, and present an enduring entanglement risk if the wires were moved into benthic foraging habitats. Subsequent colonization by encrusting organisms, burying by sediment, and chemical breakdown of the copper filament would further reduce the potential for reintroduction as an entanglement risk. The length of the guidance wires varies, as described in Section 3.0.3.3.5.1 (Wires and Cables), but greater lengths increase the likelihood that a sea turtle could become entangled. The behavior and feeding strategy of a species can determine whether it may encounter items on the seafloor, where guidance wires will most likely be available. There is potential for those species (e.g., green, hawksbill, Kemp's ridley, and loggerhead) that feed on the seafloor to encounter guidance wires and potentially become entangled; however, the relatively few guidance wires being expended within the AFTT Study Area limits the potential for encounters.

Sonobuoys consist of a surface antenna and float unit and a subsurface hydrophone assembly unit. The two units are attached through a thin-gauge, dual-conductor, hard draw copper strand wire, which is then wrapped by a hollow rubber tubing or bungee in a spiral configuration. The tensile breaking strength of the sonobuoy wire and rubber tubing is no more than 40 lb. The length of the sonobuoy wire is housed in a plastic canister dispenser, which remains attached upon deployment. The length of cable that extends out is no more than 1500 ft. and is dependent on the water depth and type of sonobuoy. Attached to the sonobuoy wire is a kite-drogue and damper disk stabilizing system made of non-woven nylon fabric. The nylon fabric is very thin and can be broken by hand. The sonobuoy wire runs through the stabilizing system and leads to the hydrophone components. The hydrophone components may be covered by thin plastic netting depending on type of sonobuoy. Each sonobuoy has a saltwater activated polyurethane float that inflates when the sonobuoy is submerged and keeps the sonobuoy components floating vertically in the water column below it. Sonobuoys remain suspended in the water column for no more than 30 hours, after which they sink to the seafloor. Several factors reduce the likelihood of sea turtle entanglement from sonobuoy components. The materials that present an entanglement risk in sonobuoys are weak, and if wrapped around an adult or juvenile sea turtle, would likely break soon after entanglement or break while bending into potentially entangling loops, although hatchlings would not likely be able to escape entrapment if entangled. These materials, however, are only temporarily buoyant and would begin sinking after use in an activity. The entanglement risk from these components would only occur when a sea turtle and these components were in close proximity, which is only in the water column. These materials would be expended in waters too deep for benthic foraging, so bottom foraging sea turtles would not interact with these materials once they sink. Some sonobuoy components, once they sink to the bottom, may be transported by bottom currents or active tidal influence, and present an enduring entanglement risk. In the benthic environment, subsequent colonization by encrusting organisms, burying by sediment, and chemical breakdown of the various materials would further reduce the potential for reintroduction as an entanglement risk.

3.8.3.5.1.1 Impacts from Wires and Cables under Alternative 1

Impacts from Wires and Cables under Alternative 1 for Training Activities

Training activities under Alternative 1 would expend wires and cables within the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, and Gulf of Mexico Range Complexes as well as other AFTT areas (see Table 3.0-39). Wires would be expended in greatest concentration within the Jacksonville Range Complex which is approximately 50,090 square nautical miles (NM^2) resulting in one wire per 2 NM^2 throughout the entire Jacksonville Range Complex. Cables would be expended in the greatest concentration within the Virginia Capes Range Complex, which is approximately 27,672 square NM^2. As a result, there would one cable per 36 NM^2 throughout the entire Virginia Capes Range Complex per year if they were expended evenly throughout the area. It should be noted that wires and cables would be expended in offshore deep water portions, and would not be an entanglement risk for sea turtles in inshore waters.

Any species of sea turtle that occurs in the Study Area could at some time encounter expended cables or wires. Based on the numbers and geographic locations of their use, wires and cables most likely pose a risk of entanglement for hatchlings and pre-recruitment juveniles of all sea turtle species, and leatherback turtles of all age classes. Wires and cables may pose a slight risk to juvenile, sub-adult, and adult loggerhead, green, and hawksbill sea turtles that have recruited to benthic foraging grounds. However, wires and cables from sonobuoys would be expended in waters too deep for benthic foraging, so bottom-foraging sea turtles (e.g., loggerhead and green turtles) would not interact with these materials once they sink. The sink rates of cables and wires would rule out the possibility of these drifting great distances into nearshore and coastal areas where juvenile, sub-adult, and adult green, hawksbill, Kemp's ridley, and loggerhead sea turtles are more likely to occur and feed on the bottom. However, if wires and cables are expended in waters where the isobaths are not greater than the benthic foraging ability (dive depth), then juvenile, sub-adult, and adult loggerhead, green, and hawksbill sea turtles could be at risk of entanglement. For example, loggerheads may forage in benthic habitats as deep as approximately 200 m (Hochscheid, 2014). Hatchlings and pre-recruitment juveniles of all sea turtle species may also occur in open-ocean habitats; however, the likelihood of impact is lower for these age classes due to their occurrence at or near the water surface by concentrated *Sargassum* mats. Activities will not be initiated near concentrated *Sargassum* mats due to the possible presence of sea turtles. Training activities that use wires and cables may cause short-term or long-term disturbance to an individual turtle because if a sea turtle were to become entangled in a cable or wire, it could free itself, or the entanglement could lead to injury or death. Potential impacts of exposure to cable or wire may result in changes to an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment. However, cables and wires are generally expected to cause an insignificant impact to sea turtles because of (1) the physical characteristics of the cables and wires; (2) the behavior of the species, as sea turtles are unlikely to become entangled in an object that is resting on the seafloor; and (3) the low concentrations of expended wires and cables in the AFTT Study Area. Given the low concentration of expended wires and cables, and the patchy distribution of sea turtles and the wires and cables expended in the offshore waters throughout the Study Area, the likelihood of encountering a wire or cable and becoming entangled is low.

Potential impacts of exposure to wires and cables are not expected to result in substantial changes in an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment, and as such are not expected to result in population-level impacts for all sea turtle species.

Proposed training activities under Alternative 1 that expend wires and cables would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy training activities that expend wires and cables would not occur within the southeast portion of loggerhead critical habitat that is designated as breeding areas, but would occur in the following loggerhead turtle designated critical habitat year round: nearshore reproductive habitat, winter areas, migratory corridors, and *Sargassum* habitat. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Wires and cables have no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to the low concentration of wires and cables that are expended, the sparse distribution of the wires and cables expended in the deeper offshore waters throughout the Study Area, the fact that the wires and cables sink upon release, and the physical properties and degradation time of the wires and cables.

Pursuant to the ESA, the use of wires and cables during training activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and would have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Wires and Cables under Alternative 1 for Testing Activities

As discussed in Section 3.0.3.3.5.1 (Wires and Cables), under Alternative 1 testing activities, fiber optic cables, guidance wires, and sonobuoy components that would pose an entanglement risk to sea turtles would be similar to those described training activities, even though testing activities occur at a higher frequency and in more locations compared to training activities. Testing activities involving wires and cables occur at Virginia Capes Range Complex, Jacksonville Range Complex, Key West Range Complex, Northeast Range Complexes, Navy Cherry Point Range Complex, Gulf of Mexico Range Complex, Naval Undersea Warfare Center Newport Testing Range, Naval Surface Warfare Center Panama City Testing Range, and South Florida Ocean Measurement Facility (see Table 3.0-40). Wires would be expended with the greatest concentration in the Northeast Range Complexes, which account for 27,798 NM^2 in size. If expended evenly throughout the area, there would be one wire per approximately 1 NM^2. Fiber optic cables would be expended with greatest concentration in the Naval Surface Warfare Center, Panama City Testing Range, which is 7,966 NM^2 in size, resulting in approximately one cable per 24 NM^2 if expended evenly throughout the area.

Any species of sea turtle that occurs in the Study Area could at some time encounter expended cables or wires. Based on the numbers and geographic locations of their use, wires and cables most likely pose a risk of entanglement for hatchlings and pre-recruitment juveniles of all sea turtle species, and leatherback turtles of all age classes. Wires and cables may pose a slight risk to juvenile, sub-adult, and adult loggerhead, green, and hawksbill sea turtles that have recruited to benthic foraging grounds. However, wires and cables from sonobuoys would be expended in waters too deep for benthic foraging, so bottom-foraging sea turtles (e.g., loggerhead and green turtles) would not interact with these materials once they sink. The sink rates of cables and wires would rule out the possibility of these drifting great distances into nearshore and coastal areas where juvenile, sub-adult, and adult green, hawksbill, Kemp's ridley, and loggerhead sea turtles are more likely to occur and feed on the bottom. However, if wires and cables are expended in waters where the isobaths are not greater than the benthic foraging ability (dive depth), then juvenile, sub-adult, and adult loggerhead, green, and hawksbill sea turtles could be at risk of entanglement. For example, loggerheads may forage in benthic habitats as deep as approximately 200 meters (Hochscheid, 2014). Hatchlings and pre-recruitment juveniles of all sea turtle species may also occur in open-ocean habitats; however, the likelihood of impact is lower for these age classes due to their occurrence at or near the water surface by concentrated *Sargassum* mats. Activities will not be initiated near concentrated *Sargassum* mats due to the possible presence of sea turtles. Testing activities that use wires and cables may cause short-term or long-term disturbance to an individual turtle because if a sea turtle were to become entangled in a cable or wire, it could free itself, or the entanglement could lead to injury or death. Potential impacts of exposure to cable or wire may result in changes to an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment. However, cables and wires are generally expected to cause an insignificant impact to sea turtles because of (1) the physical characteristics of the cables and wires; (2) the behavior of the species, as sea turtles are unlikely to become entangled in an object that is resting on the seafloor; and (3) the low concentrations of expended wires and cables in the AFTT Study Area. Given the low concentration of expended wires and cables, and the patchy distribution of sea turtles and the wires and cables expended in the offshore waters throughout the Study Area, the likelihood of encountering a wire or cable and becoming entangled is low.

Proposed testing activities under Alternative 1 that expend wires and cables would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy testing activities that expend wires and cables would occur year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Wires and cables have no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to the low concentration of wires and cables that are expended, the sparse distribution of the wires and cables expended in the deeper offshore waters throughout the Study Area, the fact that the wires and cables sink upon release, and the physical properties and degradation time of the wires and cables.

Pursuant to the ESA, the use of wires and cables during testing activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and will have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat. The Navy has consulted with the NMFS as required by section 7(a)(2) of the ESA in that regard.

3.8.3.5.1.2 Impacts from Wires and Cables under Alternative 2

Impacts from Wires and Cables under Alternative 2 for Training Activities

The locations of training activities that expend wires and cables are the same under Alternatives 1 and 2. Table 3.0-39 shows the number and location of wires and cables expended during proposed training activities. The numbers of wires and cables would be the same for Alternative 2 as for Alternative 1 except for increased numbers of sonobuoy wires in the Gulf of Mexico Range Complex, as well as increases in the number of bathythermograph wires in Virginia Capes, Navy Cherry Point, Jacksonville, and Gulf of Mexico Range Complexes. Overall, the number of wires (there would be no increases in the number of fiber optic cables) expended during training activities would increase by 2 percent annually and by 3 percent over five years. It should be noted that wires and cables would be expended in offshore deep water portions, and would not be an entanglement risk for sea turtles in inshore waters. Because activities under Alternative 2 occur at a similar rate and frequency relative to Alternative 1, entanglement stress experienced by sea turtles from guidance wires, fiber optic cables, and sonobuoy wires under Alternative 2 are not expected to be meaningfully different than those described under Alternative 1. Therefore, impacts associated with training activities under Alternative 2 are the same as Alternative 1.

As with Alternative 1, the use of wires and cables in training activities may cause short-term or long-term disturbance to an individual turtle, because if a sea turtle were to become entangled in a cable or wire, it could free itself or the entanglement could lead to injury or death. Potential impacts of exposure to cable or wire may result in changes to an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment. Potential impacts of exposure to cables and wires are not expected to result in population-level impacts.

Proposed training activities under Alternative 2 that expend wires and cables would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy training activities that expend wires and cables would not occur within the southeast portion of loggerhead critical habitat that is designated as breeding areas, but would occur in the following loggerhead turtle designated critical habitat year round: nearshore reproductive habitat, winter areas, migratory corridors, and *Sargassum* habitat. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Wires and cables have no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to the low concentration of wires and cables that are expended, the sparse distribution of the wires and cables expended in the deeper offshore waters throughout the Study Area, the fact that the wires and cables sink upon release, and the physical properties and degradation time of the wires and cables.

Pursuant to the ESA, the use of wires and cables during training activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and will have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat.

Impacts from Wires and Cables under Alternative 2 for Testing Activities

The locations of testing activities that expend wires and cables are nearly the same under Alternatives 1 and 2. Table 3.0-40 shows the number and location of wires and cables expended during proposed testing activities. The numbers of wires and cables would mostly be the same for Alternative 2 as for Alternative 1 except for increased numbers sonobuoy wires expended in the Northeast, Virginia Capes, Navy Cherry Point, and Jacksonville Range Complexes. There would also be a slight increase in the number of fiber optic cables in Virginia Capes Range Complex and NSWC Panama City Testing Range under Alternative 2. Overall, the number of wires and cables expended during testing activities would increase by 0.6 percent annually and by 3 percent over five years. The differences in species overlap and potential impacts from cables and wires on sea turtles during testing activities would not be discernible from those described for testing activities in Section 3.8.3.5.1.1 (Impacts from Wires and Cables under Alternative 1). As with Alternative 1, the use of wires and cables in testing activities may cause short-term or long-term disturbance to an individual turtle, because if a sea turtle were to become entangled in a cable or wire, it could free itself or the entanglement could lead to injury or death. Potential impacts of exposure to cable or wire may result in changes to an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment. Potential impacts of exposure to cables and wires are not expected to result in population-level impacts.

Proposed testing activities under Alternative 2 that expend wires and cables would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy testing activities that expend wires and cables would occur year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Wires and cables have no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to the low concentration of wires and cables that are expended, the sparse distribution of the wires and cables expended in the deeper offshore waters throughout the Study Area, the fact that the wires and cables sink upon release, and the physical properties and degradation time of the wires and cables.

Pursuant to the ESA, the use of wires and cables during testing activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and will have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat.

3.8.3.5.1.3 Impacts from Wires and Cables under the No Action Alternative

Impacts from Wires and Cables under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the proposed training or testing activities in the AFTT Study Area. Various entanglement stressors (e.g., wires and cables) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.8.3.5.2 Impacts from Decelerators/Parachutes

Section 3.0.3.3.5.2 (Decelerators/Parachutes) describes the types of decelerators/parachutes used during training and testing activities, while Section 3.0.3.3.4.2 (Military Expended Materials) provides the number and location of decelerators/parachutes expended during training and testing activities. Training and testing activities that introduce decelerators/parachutes into the water column can occur anywhere in the AFTT Study Area and may pose an entanglement risk to sea turtles. Potential impacts from decelerators/parachutes as ingestion stressors to sea turtles are discussed in Section 3.8.3.6.2.1 (Impacts from Military Expended Materials Other Than Munitions under Alternative 1).

Some aerial targets use large and extra-large decelerators/parachutes (see Section 3.0.3.3.5.2, Decelerators/Parachutes). Large decelerators/parachutes are up to 50 ft. in diameter and extra-large decelerators/parachutes are up to 80 ft. in diameter. The majority of these larger-sized decelerators/parachutes that would be expended are the large parachutes, with a small amount of extra-large decelerators/parachutes being expended. The large and extra-large decelerators/parachutes have long attachment cords (up to 70 ft. and 82 ft. in length, respectively), and upon water impact may remain at the surface for up to 5 minutes before eventually sinking to the seafloor. As previously stated, the rate of sinking depends upon sea conditions and the shape of the decelerator/parachute, and the duration of the descent would depend on the water depth. The decelerators/parachutes that are associated with shore-launched aerial targets have the potential to be recovered, if safety allows for it; however, this analysis assumes the decelerators/parachutes are not recovered.

While in the water column, a sea turtle is less likely to become entangled because the decelerator/parachute would have to land directly on the turtle, or the turtle would have to swim into the decelerator/parachute or its cords before it sank. This is the case for the small and medium decelerators/parachutes; however, the likelihood for entanglement is higher for the large and extra-large decelerators/parachutes due to their size and the length of the attachment cords. Prior to reaching the seafloor, the decelerator/parachute could be carried along in a current, or snagged on a hard structure near the bottom. Conversely, the decelerator/parachute and associated cords could settle to the bottom, where they would be buried by sediment in most soft bottom areas or colonized by attaching and encrusting organisms, which would further stabilize the material and reduce the potential for reintroduction as an entanglement risk. Decelerators/parachutes or decelerator/parachute cords may be a risk for sea turtles to become entangled, particularly while at the surface. A sea turtle would have to surface to breathe or grab prey from under the decelerator/parachute and swim into the decelerator/parachute or its cords in order to become entangled.

If bottom currents are present, the canopy may billow and pose an entanglement threat to sea turtles that feed in benthic habitats (i.e., green, Kemp's ridley, hawksbill, and loggerhead sea turtles). Bottom-feeding sea turtles tend to forage in nearshore and coastal areas rather than offshore, where some of these decelerators/parachutes are used. The small and medium decelerators/parachutes would be expended in offshore waters too deep for benthic foraging, so bottom-foraging sea turtles would not interact with these materials once they sink; therefore, sea turtles are not likely to encounter small and medium decelerators/parachutes once they reach the seafloor. However, some of the large and extra-large decelerators/parachutes have the potential to be expended near shore, therefore posing more of an entanglement risk to bottom-feeding sea turtles. Hatchlings and pre-recruitment juveniles would not likely be able to escape entrapment if they became entangled in a decelerator/parachute at or near the water surface. The potential for a sea turtle to encounter an expended small or medium decelerator/parachute at the surface or in the water column is extremely low, and is even less probable at the seafloor, given the general improbability of a sea turtle being near the deployed decelerator/parachute, the sparse distribution of the small and medium decelerators/parachutes expended throughout the Study Area, as well as the patchy distribution and general behavior of sea turtles; therefore, potential impacts are anticipated to be insignificant. The potential for a sea turtle to encounter an expended large or extra-large parachute at the surface, in the water column, or on the seafloor is a possibility due to their size and the length of the attachment cords as well as the potentially concentrated distribution of these decelerators/parachutes within the nearshore waters of the Study Area where there is a higher concentration of some sea turtle species; therefore, potential impacts may be significant. Depending on how quickly the decelerator/parachute may degrade, the risk may increase with time if the decelerator/parachute remains intact or if underwater currents delay settling of the decelerator/parachute on the seafloor (where they would likely be covered by sediment and encrusted). Factors that may influence degradation times include exposure to ultraviolet radiation and the extent of physical damage of the decelerator/parachute on the water's surface, as well as water temperature and sinking depth. It should be noted that no known instances of sea turtle entanglement with a decelerator/parachute assembly have been reported.

3.8.3.5.2.1 Impacts from Decelerators/Parachutes under Alternative 1

Impacts from Decelerators/Parachutes under Alternative 1 for Training Activities

Training activities under the Proposed Action would expend decelerators/parachutes within the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes, along with other areas outside the Range Complexes within the AFTT Study Area. The area with the greatest concentration of small and medium expended decelerators/parachutes would be within the Jacksonville Range Complex, where one decelerator/parachute would be expended per 2 NM^2, if evenly distributed throughout the area. It should be noted that the small and medium decelerators/parachutes would be expended in offshore deep water portions and would not be an entanglement risk for sea turtles in inshore waters. The area with the greatest concentration of large and extra-large expended decelerators/parachutes would be within the Virginia Capes Range Complex. These types of decelerators/parachutes would have the potential to be expended from shore seaward.

Any species of sea turtle that occurs in the Study Area could at some time encounter an expended decelerator/parachute. Based on the numbers and geographic locations of their use, decelerators/ parachutes and decelerator/parachute cords pose a risk of entanglement for all age classes of any sea turtle species. The sink rates of a small and medium decelerator/parachute assembly would rule out the possibility of these drifting great distances into nearshore and coastal areas where juvenile, sub-adult, and adult green, hawksbill, Kemp's ridley, and loggerhead sea turtles are more likely to occur and feed on the bottom. Although these species may feed along the seafloor, they surface periodically to breathe while feeding and moving between nearshore habitats. Kemp's ridley sea turtles can spend extended periods foraging at depth, even in open ocean areas (Sasso & Witzell, 2006; Seney, 2016; Servis et al., 2015). Leatherback turtles of all age classes are more likely to feed at or near the surface in open ocean areas, but sub-adult and adult leatherbacks may also forage at the surface and throughout the water column in coastal and sometimes estuarine waters. Hatchlings and pre-recruitment juveniles of all sea turtle species may co-occur with these activities, since these age classes occur in open-ocean habitats at or near the water surface and are usually affiliated with concentrated *Sargassum* mats. However, activities expending small and medium decelerators/parachutes will not be initiated near concentrated *Sargassum* mats due to the possible presence of sea turtles, further reducing the low likelihood of encountering an expended small or medium decelerator/parachute and entanglement risk (see Section 5.3, Procedural Mitigation to be Implemented).

Over the continental shelf and within nearshore waters, juveniles, sub-adults, and adults of all sea turtle species that have recruited to coastal foraging grounds are at risk of entanglement from the expended large and extra-large decelerators/parachutes because of greater densities of sea turtles and the potential location of these expended decelerators/parachutes (nearshore seaward). Hatchlings of all sea turtle species would also be present very briefly as they leave the nest, enter the water, and move to offshore areas to develop. Hatchlings would only be present a few months of the year between summer and fall from southern Virginia and further south. Green, Kemp's ridley, and loggerhead sea turtles are the only species that nest as far north as Virginia. Leatherback turtles may nest as far north as North Carolina. Only rare nesting activity occurs in parts of Florida for the hawksbill turtle (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2013a). Therefore, sea turtle species that occur over the continental shelf and within nearshore waters would have a greater potential for impacts.

For training activities under Alternative 1, exposure to decelerators/parachutes used in training activities may cause short-term or long-term disturbance to an individual turtle, because if a sea turtle were to become entangled in a decelerator/parachute, it could free itself, or the entanglement could lead to injury or death. Based on the general discussion presented above and in Section 3.0.3.3.5.2 (Decelerators/Parachutes), small and medium decelerators/parachutes and the associated cords are generally expected to cause an insignificant impact to sea turtles. However, large and extra-large decelerators/parachutes and the associated cords have the potential to cause a significant impact to sea turtles. Potential impacts of exposure to decelerator/parachute may result in changes to an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment. Given the number, location and size of the decelerators/parachutes and the associated cords there is the potential for disturbance to sea turtles if the decelerator/parachute were to land directly on an animal or an animal were to swim into it before it sinks. It is possible that a benthic feeding sea turtle could become entangled when foraging in areas where decelerators/parachutes have settled on the seafloor. For example, if bottom currents are present, the canopy may temporarily billow and pose a greater entanglement threat.

Potential impacts of exposure to decelerators/parachutes may result in substantial changes in an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment. Given the number and location of expended large and extra-large decelerators/parachutes, and the density of sea turtles in the area, the possibility of entanglement cannot be discounted; however, potential impacts of exposure to decelerators/parachutes are not expected to result in population-level impacts for all sea turtle species.

Given the high amount of high-speed vessel movement hours, the inshore water locations of where these activities would occur, and species' distribution throughout the Study Area, co-occurrence with individuals of loggerhead, green, Kemp's ridley, and leatherback turtles are likely, especially in the Virginia Capes Range Complex.

Proposed training activities under Alternative 1 that use decelerators/parachutes would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy training activities that expend decelerators/parachutes would occur year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Decelerators/parachutes have no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to the low concentration of decelerators/parachutes that are expended, the sparse distribution of the decelerators/parachutes expended in the deeper offshore waters throughout the Study Area, the fact that assemblies are designed to sink rapidly through the water column.

Pursuant to the ESA, the use of decelerators/parachutes during training activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and will have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Decelerators/Parachutes under Alternative 1 for Testing Activities

Testing activities under Alternative 1 testing activities would expend decelerators/parachutes primarily within the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes. Other locations include the Naval Undersea Warfare Center Newport Testing Range; South Florida Ocean Measurement Facility Testing Range; and the Naval Surface Warfare Center, Panama City Testing Range. Small and medium decelerators/parachutes would be expended with greatest concentration in the Virginia Capes Range Complex; approximately one decelerator/parachute would be expended per 3 NM^2, if evenly distributed throughout the area. It should be noted that small and medium decelerators/parachutes would be expended in offshore deep water portions and would not be an entanglement risk for sea turtles in inshore waters. The area with the greatest concentration of large expended decelerators/parachutes would be within the Virginia Capes Range Complex. This type of decelerator/parachute has the potential to be expended from shore seaward. Fewer decelerators/parachutes of this size will be expended during testing activities compared to training activities. Extra-large decelerators/parachutes would not be expended during testing activities.

Any species of sea turtle that occurs in the Study Area could at some time encounter an expended decelerator/parachute. Based on the numbers and geographic locations of their use, decelerators/ parachutes and decelerator/parachute lines pose a risk of entanglement for all age classes of any sea turtle species. The sink rates of a small and medium decelerator/parachute assembly would rule out the possibility of these drifting great distances into nearshore and coastal areas where juvenile, sub-adult, and adult green, hawksbill, Kemp's ridley, and loggerhead sea turtles are more likely to occur and feed on the bottom. Although these species may feed along the seafloor, they surface periodically to breathe while feeding and moving between nearshore habitats. Kemp's ridley sea turtles can spend extended periods foraging at depth, even in open ocean areas (Sasso & Witzell, 2006; Seney, 2016; Servis et al., 2015). Leatherback turtles of all age classes are more likely to feed at or near the surface in open ocean areas, but sub-adult and adult leatherbacks may also forage at the surface and throughout the water column in coastal and sometimes estuarine waters. Hatchlings and pre-recruitment juveniles of all sea turtle species may also co-occur with these activities, since these age classes occur in open-ocean habitats at or near the water surface and are usually affiliated with concentrated *Sargassum* mats. However, activities will not be initiated near concentrated *Sargassum* mats due to the possible presence of sea turtles, further reducing the low likelihood of encountering an expended small or medium decelerator/parachute and entanglement risk.

Over the continental shelf and within nearshore waters, juveniles, sub-adults, and adults of all sea turtle species that have recruited to coastal foraging grounds, are at risk of entanglement from the expended large decelerators/parachutes because of greater densities of sea turtles and the potential location of these expended decelerators/parachutes (nearshore seaward). Hatchlings of all sea turtle species would also be present very briefly as they leave the nest, enter the water, and move to offshore areas to develop. Hatchlings would only be present a few months of the year between summer and fall from southern Virginia and further south. Green, Kemp's ridley, and loggerhead turtles are the only species that nest as far north as Virginia. Leatherback turtles may nest as far north as North Carolina. Only rare nesting activity occurs in parts of Florida for the hawksbill turtle (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2013a). Therefore, sea turtle species that occur over the continental shelf and within nearshore waters would have a greater potential for impacts.

Exposure to decelerators/parachutes used in testing activities may cause short-term or long-term disturbance to an individual turtle, because if a sea turtle were to become entangled in a decelerator/parachute, it could free itself, or the entanglement could lead to injury or death. Based on the general discussion presented above, small and medium decelerators/parachutes and the associated cords are generally expected to cause an insignificant impact to sea turtles. Large decelerators/parachutes and the associated cords have the potential to cause a significant impact to sea turtles; however, decelerators/parachutes are not as frequently expended during testing activities, and therefore the likelihood of an impact is low. Potential impacts of exposure to decelerator/parachute may result in changes to an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment. Given the location and size of the decelerators/parachutes and the associated cords there is the potential for disturbance to sea turtles if the decelerator/parachute were to land directly on an animal, or an animal were to swim into it before it sinks, although the likelihood of this type of disturbance is low. It is possible that a benthic feeding sea turtle could become entangled when foraging in areas where decelerators/parachutes have settled on the seafloor. For example, if bottom currents are present, the canopy may temporarily billow and pose a greater entanglement threat. However, the potential for a sea turtle to encounter an expended decelerator/parachute at the surface or in the water column is low, and it is even less probable at the seafloor, given the general improbability of a sea turtle being near the deployed decelerator/parachute and the distribution of sea turtles and of the decelerators/parachutes expended throughout the Study Area.

Based on the number of decelerators/parachutes expended under testing activities for the Proposed Action, the small footprint of impact, and the low likelihood of a decelerator/parachute assembly landing directly on a sea turtle or a sea turtle swimming directly into it, insignificant impacts on sea turtles are anticipated. While entanglement is a serious stressor for sea turtles from a wide range of debris in the ocean, decelerators/parachutes used during military testing activities are an unlikely source.

Potential impacts of exposure to decelerators/parachutes are not expected to result in substantial changes in an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment, and as such are not expected to result in population-level impacts for all sea turtle species from testing activities under Alternative 1.

Proposed testing activities under Alternative 1 that use decelerators/parachutes would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy testing activities that expend decelerators/parachutes would occur year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Decelerators/parachutes have no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to the low concentration of decelerators/parachutes that are expended, the sparse distribution of the decelerators/parachutes expended in the deeper offshore waters throughout the Study Area, and the fact that assemblies are designed to sink rapidly through the water column upon release and either break down or be encrusted with benthic organisms if settled on the seafloor.

Pursuant to the ESA, the use of decelerators/parachutes during testing activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and will have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA in that regard.

3.8.3.5.2.2 Impacts from Decelerators/Parachutes under Alternative 2

Impacts from Decelerators/Parachutes under Alternative 2 for Training Activities

Under Alternative 2, the number of decelerators/parachutes that would be expended during training activities would be similar to Alternative 1 within Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, and Key West Range Complexes, and entanglement stress experienced by sea turtles from decelerators/parachutes under Alternative 2 is not expected to be meaningfully different than what is described under Alternative 1. Therefore, the impact conclusion for decelerators/parachutes under Alternative 2 training activities is the same as for Alternative 1. Within the Gulf of Mexico Range Complex, the number of parachutes would increase compared to Alternative 1; thereby exposing more sea turtles in open ocean habitats within the Gulf of Mexico.

Proposed training activities under Alternative 2 that use decelerators/parachutes would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy testing activities that expend decelerators/parachutes would occur year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Decelerators/parachutes have no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to the low concentration of decelerators/parachutes that are expended, the sparse distribution of the decelerators/parachutes expended in the deeper offshore waters throughout the Study Area, and the fact that assemblies are designed to sink rapidly through the water column upon release and either break down or be encrusted with benthic organisms if settled on the seafloor.

Pursuant to the ESA, the use of decelerators/parachutes during training activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and will have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat.

Impacts from Decelerators/Parachutes under Alternative 2 for Testing Activities

The locations of testing activities that expend decelerators/parachutes are the same under Alternatives 1 and 2. However, the total number of decelerators/parachutes expended during testing activities would increase by approximately 2 percent annually and by 8 percent over five years. This level of increase is not expected to appreciably increase the risk of entanglement to sea turtles that occur in these areas. Potential impacts from testing activities that expend decelerators/parachutes presented in Section 3.8.3.5.2.1 (Impacts from Decelerators/Parachutes under Alternative 1) for testing activities would be applicable to testing activities under Alternative 2. Therefore, the Navy anticipates that no sea turtles would become entangled in decelerators/parachutes.

Proposed testing activities under Alternative 2 that use decelerators/parachutes would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy testing activities that expend decelerators/parachutes would occur year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Decelerators/parachutes have no pathway to impact the physical and biological features identified for these habitats (National Marine

Fisheries Service, 2014b) due to the low concentration of decelerators/parachutes that are expended, the sparse distribution of the decelerators/parachutes expended in the deeper offshore waters throughout the Study Area, and the fact that assemblies are designed to sink rapidly through the water column upon release and either break down or be encrusted with benthic organisms if settled on the seafloor.

Pursuant to the ESA, the use of decelerators/parachutes during testing activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and will have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat.

3.8.3.5.2.3 Impacts from Decelerators/parachutes under the No Action Alternative

Impacts from Decelerators/parachutes under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the proposed training or testing activities in the AFTT Study Area. Various entanglement stressors (e.g., decelerators/parachutes) would not be introduced into the marine environment. Therefore baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.8.3.5.3 Impacts from Biodegradable Polymer

For a discussion of the types of activities that use biodegradable polymers see Appendix B (Activity Stressor Matrices) and for a discussion on where they are used and how many activities would occur under each alternative, see Section 3.0.3.3.5.3 (Biodegradable Polymer). Navy activities that involve vessel entanglement systems include the development of the biodegradable polymer and would be associated with testing activities in the AFTT Study Area. As indicated by its name, vessel entanglement systems that make use of biodegradable polymers are designed to entangle the propellers of in-water vessels, which would significantly slow and potentially stop the advance of the vessel. A biodegradable polymer is a high molecular weight polymer that degrades to smaller compounds as a result of microorganisms and enzymes. The rate of biodegradation could vary from hours to years and the type of small molecules formed during degradation can range from complex to simple products, depending on whether the polymers are natural or synthetic (Karlsson & Albertsson, 1998). Based on the constituents of the biodegradable polymer the Navy proposes to use, it is anticipated that the material will breakdown into small pieces within a few days to weeks. This will breakdown further and dissolve into the water column within weeks to a few months. The final products which are all environmentally benign will be dispersed quickly to undetectable concentrations. Unlike other entanglement stressors, biodegradable polymers only retain their strength for a relatively short period of time, therefore the potential for entanglement by a sea turtle would be limited. Furthermore, the longer the biodegradable polymer remains in the water, the weaker it becomes making it more brittle and likely to break. A sea turtle would have to encounter the biodegradable polymer immediately after it was expended for it to be a potential entanglement risk. If an animal were to encounter the polymer a few hours after it was expended, it is very likely that it would break easily and would no longer be an entanglement stressor. Hatchlings, however, would not likely be able to escape entrapment if they became entangled in a biodegradable polymer if entanglement occurred. Biodegradable polymers would only be a risk to hatchlings while the biodegradable polymer retained its tensile strength. As stated above for larger life stages, this is likely in the timeframe of a few hours after expending, but for hatchlings, a lower tensile strength would be required; therefore, the risk to hatchlings would extend over weeks. Due to the wide dispersion and low numbers of biodegradable polymers as well as the patchy distribution of sea turtles, there is a low likelihood of sea turtles, especially hatchlings, interacting with biodegradable polymers while they are an entanglement risk.

3.8.3.5.3.1 Impacts from Biodegradable Polymer under Alternative 1

Impacts from Biodegradable Polymer under Alternative 1 for Training Activities

Biodegradable polymers would not be used during Navy training activities under Alternative 1.

Impacts from Biodegradable Polymer under Alternative 1 for Testing Activities

Testing activities under the Proposed Action that use biodegradable polymers would be conducted within the Virginia Capes, Jacksonville, Key West, and Gulf of Mexico Range Complexes, as well as the Naval Undersea Warfare Division, Newport Testing Range. The number of testing activities involving biodegradable polymers conducted in these areas is relatively low, as discussed in Section 3.0.3.3.5.3 (Biodegradable Polymer) and shown in Table 3.0-42.

Based on the geographic locations of their use and the fact that they may be expended within the coastal zone (3 or 9 NM from shore depending on the state), biodegradable polymers could have the potential to impact all age classes of all sea turtle species. Hatchlings and pre-recruitment juveniles of all sea turtle species, occasionally adult loggerhead turtles, and leatherback turtles of all age classes would most likely be impacted if biodegradable polymers were expended in offshore waters of the Virginia Capes, Jacksonville, Key West, and Gulf of Mexico Range Complexes, as well as the Naval Undersea Warfare Division, Newport Testing Range. Sea turtles are expected to be highly dispersed in offshore waters, and co-occurrence with testing activities is unlikely.

For testing activities that may occur within the coastal zone, juvenile, sub-adult, and adult loggerhead, green, Kemp's ridley and hawksbill sea turtles that have recruited to benthic foraging grounds in coastal waters would most likely be impacted. Sub-adult and adult leatherbacks that forage at the surface and throughout the water column in coastal waters may also be impacted. Hatchlings of all sea turtle species would also be present very briefly as they leave the nest, enter the water, and move to offshore areas to develop. Hatchlings would only be present a few months of the year from southern Virginia and further south. Green, Kemp's ridley, and loggerhead sea turtles are the only species that nest as far north as Virginia. Leatherback sea turtles may nest as far north as North Carolina. Only rare nesting activity occurs in parts of Florida for the hawksbill sea turtle (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2013a).

No more than 30 testing events using biodegradable polymers are planned per year in the Virginia Capes, Jacksonville, Key West, and Gulf of Mexico Range Complexes, as well as the Naval Undersea Warfare Division, Newport Testing Range. Given the very low number of events and species' distribution, co-occurrence with individuals of any species is very unlikely, especially in northern areas.

Based on the general discussion presented above and in Section 3.8.3.5.3 (Impacts from Biodegradable Polymer), biodegradable polymers are generally expected to cause a discountable impact to all sea turtle species. Provided the low level of activity, the concentration of these items being expended throughout these areas is likewise considered low, which would result in a very low potential for all sea turtles to encounter biodegradable polymers. In addition, there is only a short duration that a sea turtle would be exposed to an entanglement risk due to the physical properties of the biodegradable polymer, further making the likelihood of entanglement extremely low. The Navy does not anticipate that any sea turtles would become entangled with biodegradable polymers.

Potential impacts of exposure to biodegradable polymers are not expected to result in substantial changes in an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment, and as such are not expected to result in population-level impacts for all sea turtle species.

Proposed testing activities under Alternative 1 that use biodegradable polymers would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy testing activities that expend biodegradable polymers would occur year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Biodegradable polymers have no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to the low concentration of biodegradable polymers that are expended, the sparse distribution of the biodegradable polymers expended throughout the Study Area, and the fact that biodegradable polymers are expected to degrade rapidly in water with the final products dispersed quickly to undetectable concentrations.

Pursuant to the ESA, the use of biodegradable polymers during testing activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and will have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA in that regard.

3.8.3.5.3.2 Impacts from Biodegradable Polymer under Alternative 2

Impacts from Biodegradable Polymer under Alternative 2 for Training Activities

Biodegradable polymers would not be used during Navy training activities under Alternative 2.

Impacts from Biodegradable Polymer under Alternative 2 for Testing Activities

The location and number of testing activities that expend biodegradable polymers under Alternative 2 would be identical to what is proposed under Alternative 1. The analysis presented in Section 3.8.3.5.3.1 (Impacts from Biodegradable Polymer under Alternative 1) for testing activities would also apply to Alternative 2.

Proposed testing activities under Alternative 2 that use biodegradable polymers would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy testing activities that expend biodegradable polymers would occur year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Biodegradable polymers have no pathway to impact the physical and biological features identified for these habitats (National Marine Fisheries Service, 2014b) due to the low concentration of biodegradable polymers that are expended, the sparse distribution of the biodegradable polymers expended throughout the Study Area, and the fact that biodegradable polymers are expected to degrade rapidly in water with the final products dispersed quickly to undetectable concentrations.

Pursuant to the ESA, the use of biodegradable polymers during testing activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and will have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat.

3.8.3.5.3.3 Impacts from Biodegradable Polymer under the No Action Alternative

Impacts from Biodegradable Polymer under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the proposed testing activities in the AFTT Study Area. Biodegradable polymer use is not a part of ongoing Navy activities in the Study Area and this entanglement stressor would not be introduced into the marine environment under the No Action Alternative. Therefore, no change in baseline conditions of the existing environment would occur.

3.8.3.6 Ingestion Stressors

This section analyzes the potential impacts of the various types of ingestion stressors used during training and testing activities within the Study Area. This analysis includes the potential impacts from the following types of military expended materials: non-explosive practice munitions (small- and medium-caliber), fragments from high-explosives, fragments from targets, chaff, flare casings (including plastic end caps and pistons), decelerators/parachutes, and biodegradable polymers. For a discussion on the types of activities that use these materials refer to Appendix B (Activity Stressor Matrices) and for a discussion on the various types of ingestion stressors, see Section 3.0.3.3.6 (Ingestion stressors); for the amounts and locations of each ingestion stressor used under each alternative, see Section 3.0.3.3.4.2 (Military Expended Materials). General discussion of impacts can also be found in Section 3.0.3.6.5 (Conceptual Framework for Assessing Effects from Ingestion). These activities would occur in offshore and inshore training and testing locations that overlap with all species of sea turtles, American alligators, and diamondback terrapins. Because military expended materials would not be used in areas that overlap with the American crocodile known range or critical habitat designated for this species, the American crocodile is not analyzed for potential ingestion risks from expending materials during training or testing activities.

The potential impacts from ingesting these materials is dependent upon the probability of the animal encountering these items in their environment, which is primarily contingent on where the items are expended and how a sea turtle feeds. Sea turtles commonly mistake debris for prey, and ingestion can cause injury or mortality. The United Nations Environment Program estimates that approximately 6.4 million tons of anthropogenic debris enters the marine environment every year (United Nations Environmental Program, 2005). Plastic is the primary type of debris found in marine and coastal environments, and plastics are the most common type of marine debris ingested by sea turtles (Schuyler et al., 2014). Sea turtles can mistake debris for prey; one study found 37 percent of dead leatherback turtles to have ingested various types of plastic (Mrosovsky et al., 2009), and Narazaki et al. (2013) noted an observation of a loggerhead exhibiting hunting behavior on approach to a plastic bag, possibly mistaking the bag for a jelly fish. Even small amounts of plastic ingestion can cause an obstruction in a sea turtle's digestive track and mortality (Bjorndal et al., 1994; Bjorndal, 1997), and hatchlings are at risk for ingesting small plastic fragments. Ingested plastics can also release toxins, such as bisphenol-A (commonly known as "BPA") and phthalates, or absorb heavy metals from the ocean and release those into tissues (Fukuoka et al., 2016; Teuten et al., 2007). The risk is prolific throughout sea turtle habitats; ingestion of expended materials by sea turtles could occur in all large marine ecosystems and open ocean areas and can occur at the surface, in the water column, or at the seafloor, depending on the size and buoyancy of the expended object and the feeding behavior of the turtle. Life stage and feeding preference affects the likelihood of ingestion. Turtles living in oceanic or coastal environments and feeding in the open ocean or on the seafloor may encounter different types and densities of debris, and may therefore have different probabilities of ingesting debris. For example, floating material could be eaten by turtles such as leatherbacks (all age classes), and by juveniles and hatchlings of all species that feed at or near the water surface. It is well documented that these species and age classes are prone to ingesting non-prey items (Hardesty & Wilcox, 2017; Mitchelmore et al., 2017; Schuyler et al., 2014; Schuyler et al., 2016). Materials that sink to the seafloor pose a risk to bottom-feeding sea turtles such as loggerheads, Kemp's ridleys, hawksbills, and greens. In 2014, Schuyler et al. (2014) reviewed 37 studies of debris ingestion by sea turtles, showing that young oceanic sea turtles are more likely to ingest debris (particularly plastic), and that green and loggerhead turtles were significantly more likely to ingest debris than other sea turtle species.

The consequences of ingestion could range from temporary and inconsequential to long-term physical stress or even death. Ingestion of these items may not be directly lethal; however, ingestion of plastic and other fragments can restrict food intake and have sublethal impacts caused by reduced nutrient intake (McCauley & Bjorndal, 1999). Poor nutrient intake can lead to decreased growth rates, depleted energy, reduced reproduction, and decreased survivorship. These long-term sublethal effects may lead to population-level impacts, but the extent of these impacts is difficult to assess because the affected individuals remain at sea and the trends may only arise after several generations have passed. Schuyler et al. (2014) determined that most sea turtles at some point will ingest some amount of debris. However, military expended materials have not been documented to be ingested by sea turtles, although whether this is because of a lack of occurrence or an inability to distinguish military expended materials from other ingested items is unknown. Because bottom-feeding occurs in nearshore areas, materials that sink to the seafloor in the open ocean are less likely to be ingested due to their location. While these depths may be within the diving capabilities of most sea turtle species, especially leatherback turtles, bottom foraging species (i.e., greens, hawksbills, Kemp's ridleys, and loggerheads) are more likely to forage in the shallower waters less than 100 m in depth. This overlaps with only a small portion of the depth range at which munitions are expended. However, loggerhead turtles may forage in benthic habitats as deep as 200 m (Hochscheid, 2014).

Rosenblatt et al. (2015) examined stomach content results collected from 960 American alligators, showing alligators have a diverse array of prey items (e.g., crustaceans, mollusks, fishes, amphibians, reptiles, mammals, birds, aquatic and terrestrial insects, and seeds), with individual alligators demonstrating diet specialization. Alligator populations inhabiting lakes exhibited lower specialization than coastal populations, likely driven by variation in habitat type and available prey types available to individual alligators in estuaries and other coastal habitats. Ingestion risk of non-prey items does not appears to be a concern while alligators are engaging in normal hunting behaviors (Nifong & Silliman, 2017).

Diamondback terrapins would be exposed to ingestion risks within inshore training and testing locations. appear to be dietary generalists and opportunistic in foraging habits with a wide array of prey and forage items, which may increase the risk of ingestion for non-prey items. As visual predators, however, diamondback terrapins appear to use visual cues while foraging, showing selectivity in the prey that they eat (Outerbridge et al., 2017). Tulipani and Lipcius (2014) found that different age classes and sex of Chesapeake Bay diamondback terrapins influenced diet, with larger females consuming larger snails, crabs, and small amphibians and other reptiles, while smaller males and females consumed plant material (e.g., grass, seeds), insects, and small crustaceans. In a study of fecal samples from 42 different diamondback terrapins in Bermuda (the only native population of diamondback terrapins outside of the

United States), Outerbridge et al. (2017) found that only one sample contained non-prey items (a cigarette filter), with the remaining 41 samples containing natural prey and forage items. The trash item came from an adult female fecal sample, while samples from adult males, juveniles, and neonates (hatchlings) did not contain any trash items. This one study seems to indicate that consumption of marine debris is not a major threat for terrapins; however, large individual terrapins, particularly the larger females, are most at risk of ingesting non-prey items.

3.8.3.6.1 Impacts from Military Expended Material – Munitions

Many different types of explosive and non-explosive practice munitions are expended at sea during training and testing activities. Types of non-explosive practice munitions generally include projectiles, missiles, and bombs. Of these, only small- or medium-caliber projectiles would be small enough for a reptile to ingest in offshore and inshore waters. Small- and medium-caliber projectiles include all sizes up to and including 2.25 in. (57 mm) in diameter. These are solid metal munitions; therefore, even if a reptile did try to bite a larger munition, the munition would not break apart and be ingestible. These solid metal materials would quickly move through the water column and settle to the seafloor. Ingestion of non-explosive practice munitions is not expected to occur in the water column because the munitions sink quickly.

A sea turtle would have to be undetected by Navy Lookouts (i.e., observers) prior to the commencement of training and testing activities (Section 5.3, Procedural Mitigation to be Implemented), be immediately adjacent to falling munitions, mistake sinking munitions for prey items, and react quickly enough to ingest the sinking material. This chain of events is highly unlikely given the Navy's mitigation measures, density of animals in the study area, rapid sinking of munitions in the water column, and general movement speed of the animals involved. Instead, they are most likely to be encountered by species that forage on the bottom (i.e., loggerhead, green, Kemp's ridley, and hawksbill sea turtles). Types of high-explosive munitions that can result in fragments include demolition charges, projectiles, missiles, and bombs. Fragments would result from fractures in the munitions casing and would vary in size depending on the size of the net explosive weight and munitions type; however, typical sizes of fragments are unknown. These solid metal materials would quickly move through the water column and settle to the seafloor; therefore, ingestion is not expected by most species. Fragments are primarily encountered by species that forage on the bottom. Other munitions and munitions fragments such large-caliber projectiles or intact training and testing bombs are too large for loggerhead, green, Kemp's ridley, and hawksbill sea turtles to consume and are made of metal so they cannot be broken up by sea turtles.

In inshore waters, however, training and testing activities would expend small caliber munitions shells into waters, and if they overlapped with benthic foraging of sea turtles, American alligators, diamondback terrapins present a higher risk of ingestion.

Sublethal effects due to ingestion of munitions used in training and testing activities may cause short-term or long-term disturbance to an individual reptiles because: (1) if a reptile were to incidentally ingest and swallow a metal fragment, it could potentially disrupt its feeding behavior or digestive processes; and (2) if the item is particularly large in proportion to the reptile ingesting it, the item could become permanently encapsulated by the stomach lining, with a rare chance that this could impede the reptile's ability to feed or take in nutrients. Potential impacts of exposure to munitions may result in changes to an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment.

In open ocean environments, munitions used in training activities are generally not expected to cause disturbance to sea turtles because: (1) sea turtles are not expected to encounter most small- and medium-caliber projectiles or high-explosive fragments on the seafloor because of the depth at which these would be expended; and (2) in some cases, a turtle would likely pass the projectile through their digestive tract and expel the item without impacting the individual. For example, Schuyler et al. (2014) noted that less than 10 percent of sea turtles (out of a sample size of 454 turtles) that ingested a wide range of debris suffered mortality, and 4 percent of turtles necropsied were killed by plastics ingestion (out of a sample size of 1,106 necropsied turtles). Because juvenile and adult green, loggerhead, Kemp's ridley, and hawksbill sea turtles feed along the seafloor, they are more likely to encounter munitions of ingestible size that settle on the bottom than leatherbacks that primarily feed at the surface and in the water column. Additionally, activities will not be initiated near concentrated *Sargassum* mats due to the possible presence of sea turtles (see Section 5.3, Procedural Mitigation to be Implemented); therefore, the likelihood of hatchlings and pre-recruitment juveniles encountering munitions is even further unlikely. Furthermore, these four species typically use nearshore feeding areas, while leatherbacks are more likely to feed in the open ocean. Given the very low probability of a leatherback encountering and ingesting materials on the seafloor or water column or any other species encountering munitions in the water column, this analysis will focus on green, loggerhead, Kemp's ridley, and hawksbill turtles and ingestible materials expended nearshore, within range complexes and testing ranges.

A discussion of the types, numbers, and locations of activities using these devices under each alternative is presented in Sections 3.0.3.3.6.1 (Non-Explosive Practice Munitions) and 3.0.3.3.6.2 (Fragments from High-Explosive Munitions).

3.8.3.6.1.1 Impacts from Military Expended Materials – Munitions under Alternative 1

Impacts from Military Expended Materials – Munitions under Alternative 1 for Training Activities

As provided in Tables 3.0-24, 3.0-25 and 3.0-27, offshore training activities involving non-explosive practice munitions and high-explosive munitions fragments would occur within the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes, as well as other AFTT areas outside of the range complexes. The Virginia Capes and Jacksonville Range Complexes have the highest estimated annual numbers of munitions for training activities (see Section 3.0.3.3.6.2, Fragments from High-Explosive Munitions). In addition, training activities that expend non-explosive practice munitions would occur within inshore waters including and surrounding Narragansett, Rhode Island; James River and Tributaries, Virginia; the Lower Chesapeake Bay, Virginia; Cooper River, South Carolina; and Port Canaveral, Florida (see Table 3.0-33).

For training activities occurring in the offshore waters, the species and age classes that may be impacted are juvenile, sub-adult, and adult loggerhead, Kemp's ridley, green, and hawksbill sea turtles, especially if munitions are expended in waters where the isobaths are not greater than the benthic foraging ability (dive depth); there is a low probability that leatherback sea turtles could be impacted. For example, hawksbill turtles and adult loggerheads may be found foraging in waters as deep as 80 m and 200 m, respectively (Hochscheid, 2014). Juvenile sea turtles (e.g., green turtles) may rest and forage in waters as deep as approximately 30 m (Hochscheid, 2014). Sea turtles are expected to be highly dispersed in offshore waters. Repeated exposures to sea turtles are not anticipated as these offshore areas do not have resident animals year round.

In open ocean environments, munitions used in training activities are generally not expected to cause disturbance or long-term effects to individual sea turtles or their populations because (1) sea turtles are not expected to encounter most small- and medium-caliber projectiles or high-explosive fragments on the seafloor because the depth at which these would be expended precludes foraging; and (2) in the unexpected circumstance of a sea turtle foraging at depths greater than 200m, a turtle would likely pass the projectile through its digestive tract and expel the item without significantly impacting the individual permanently. For example, Schuyler et al. (2014) noted that less than 10 percent of sea turtles (out of a sample size of 454 turtles) that ingested a wide range of debris suffered mortality, and 4 percent of turtles necropsied were killed by plastics ingestion (out of a sample size of 1,106 necropsied turtles). In offshore waters, the amount of non-explosive practice munitions and high-explosive munitions fragments that an individual sea turtle would encounter is generally low based on the patchy distribution of both the munitions and sea turtles.

Navy training activities involving non-explosive practice munitions in the inshore waters occur in several locations along the Atlantic coast, but substantially less munitions would be expended annually compared to the activities in the offshore areas (see Section 3.0.3.3.6.2, Fragments from High-Explosive Munitions). The highest concentration of munitions would be expended in the James River and Tributaries. Other locations include the Lower Chesapeake Bay, Virginia; Port Canaveral, Florida; and Narragansett Bay, Rhode Island. In inshore waters, training activities would concentrate small-caliber shell casings in areas that may potentially be overly benthic foraging areas (e.g., Lower Chesapeake Bay and Port Canaveral). Juvenile, sub-adult, and adult green, loggerhead, Kemp's ridley, and hawksbill sea turtles that have recruited to benthic foraging grounds are more likely to encounter munitions of ingestible size that settle on the bottom since these species and age classes feed along the seafloor. There is a low probability that sub-adult and adult leatherbacks that forage in coastal waters could be impacted.

Based on the discussion presented above, the likelihood that a sea turtle would encounter and subsequently ingest a military expended item associated with Navy training activities in inshore waters and offshore waters is considered low, and munitions are generally expected to cause an insignificant impact to sea turtles. Adverse impacts from ingestion of military expended materials would be limited to the unlikely event that a sea turtle would be harmed by ingesting an item that becomes embedded in tissue or is too large to be passed through the digestive system. In addition, a sea turtle would not likely ingest every projectile it encountered. A sea turtle may attempt to ingest a projectile or fragment and then reject it when it realizes it is not a food item. Therefore, potential impacts of non-explosive practice munitions and fragments ingestion would be limited to the unlikely event in which a sea turtle might suffer a negative response from ingesting an item that becomes embedded in tissue or is too large to be passed through the digestive system. The Navy considers the likelihood of this occurring to be very low.

Potential impacts of exposure to non-explosive practice munitions and high-explosive munitions fragments are not expected to result in substantial changes in an individual sea turtle's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment, and as such are not expected to result in population-level impacts for all sea turtle species.

Munitions in inshore waters would be expended in areas potentially occupied by American alligators at Cooper River, South Carolina; and Port Canaveral, Florida. As stated above in Section 3.8.3.6 (Ingestion Stressors), American alligators are generalist predators, but they may specialize in specific prey items depending on habitat, age class of the alligator, and behaviors specific to individual alligators. In inshore waters, training activities would concentrate small-caliber shell casings in areas that may potentially be used for benthic foraging by alligators; however, this hunting behavior is generally rare for alligators. There is a very low probability that American alligators foraging in estuarine habitats would encounter expended munitions. If an alligator did encounter expended munitions, it is unlikely that an American alligator would mistake munitions fragments or casings for prey items. Potential impacts of exposure to non-explosive practice munitions and high-explosive munitions fragments are not expected to result in substantial changes in an individual alligator's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment, and as such are not expected to result in population-level impacts for the American alligator.

Munitions in inshore waters would be expended in areas potentially occupied by diamondback terrapins in waters surrounding Narragansett, Rhode Island; James River and Tributaries, Virginia; the Lower Chesapeake Bay, Virginia; Cooper River, South Carolina; and Port Canaveral, Florida. In inshore waters, training activities would concentrate small-caliber shell casings in estuarine areas that may potentially be used by terrapins while foraging for benthic prey items (e.g., crustaceans, molluscs). There is a very low probability that diamondback terrapins foraging in estuarine habitats would encounter expended munitions. Diamondback terrapins are believed to use visual cues for foraging for benthic prey; therefore, it is unlikely that a diamondback terrapin would mistake munitions fragments or casings for prey items. Potential impacts of exposure to non-explosive practice munitions and high-explosive munitions fragments are not expected to result in substantial changes in an individual terrapin's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment, and as such are not expected to result in population-level impacts for the diamondback terrapin.

Proposed training activities under Alternative 1 that expend munitions would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy training activities that expend munitions would occur year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Munitions that pose ingestion risk have no way of impacting the habitat types that comprise loggerhead turtle critical habitat (National Marine Fisheries Service, 2014b).

Pursuant to the ESA, activities that release military expended materials-munitions during training activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and will have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Military Expended Materials – Munitions under Alternative 1 for Testing Activities

As provided in Tables 3.0-26 and 3.0-28, testing activities involving non-explosive practice munitions and high-explosive munitions fragments would be expended within the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes, as well as the Naval Undersea Warfare Center Newport Testing Range, the South Florida Ocean Measurement Facility, and the Naval Surface Warfare Center Panama City Testing Range. No testing activities would release munitions or fragments in inshore waters; therefore, only sea turtles in offshore areas are analyzed for potential impacts from non-explosive practice munitions and high-explosive munitions fragments under Alterative 1 testing activities.

For testing activities, the species and age classes that may be impacted are juvenile, sub-adult, and adult loggerhead, Kemp's ridley, green, and hawksbill sea turtles, especially if non-explosive practice munitions and high-explosive munitions fragments are expended in waters where the isobaths are not greater than the benthic foraging ability (dive depth); there is a low probability that leatherback turtles could be impacted. For example, hawksbill turtles and adult loggerheads may be found foraging in waters as deep as 80 m and 200 m, respectively (Hochscheid, 2014). Juvenile sea turtles (e.g., green turtles) may rest and forage in waters as deep as approximately 30 m (Hochscheid, 2014). Sea turtles are expected to be highly dispersed in offshore waters. Repeated exposures to sea turtles are not anticipated as these offshore areas do not have resident animals year round.

In open ocean environments, munitions used in testing activities are generally not expected to cause disturbance or long-term effects to individual sea turtles or their populations because (1) sea turtles are not expected to encounter most small- and medium-caliber projectiles or high-explosive fragments on the seafloor because the depth at which these would be expended precludes foraging; and (2) in the unexpected circumstance of a sea turtle foraging at depths greater than 200m, a turtle would likely pass the projectile through its digestive tract and expel the item without significantly impacting the individual permanently. For example, Schuyler et al. (2014) noted that less than 10 percent of sea turtles (out of a sample size of 454 turtles) that ingested a wide range of debris suffered mortality, and 4 percent of turtles necropsied were killed by plastics ingestion (out of a sample size of 1,106 necropsied turtles). In open ocean and nearshore waters, the amount of non-explosive practice munitions and high-explosive munitions fragments that an individual sea turtle would encounter is generally low based on the patchy distribution of both the munitions and sea turtles.

Based on the discussion presented above, the likelihood that a sea turtle would encounter and subsequently ingest a military expended item associated with Navy testing activities is considered low. Adverse impacts from ingestion of military expended materials would be limited to the unlikely event that a sea turtle would be harmed by ingesting an item that becomes embedded in tissue or is too large to be passed through the digestive system. In addition, a sea turtle would not likely ingest every projectile it encountered. A sea turtle may attempt to ingest a projectile or fragment and then reject it when it realizes it is not a food item. Therefore, potential impacts of non-explosive practice munitions and fragments ingestion would be limited to the unlikely event in which a sea turtle might suffer a negative response from ingesting an item that becomes embedded in tissue or is too large to be passed through the digestive system. As with the analysis for training activities, the Navy considers the potential for ingestion of munitions and fragments to be very low.

Potential impacts of exposure to non-explosive practice munitions and high-explosive munitions fragments are not expected to result in substantial changes in an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment, and as such are not expected to result in population-level impacts for all sea turtle species.

Proposed testing activities under Alternative 1 that expend munitions would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy testing activities that expend munitions would occur year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Munitions that pose ingestion risk have no way of impacting the habitat types that comprise loggerhead turtle critical habitat (National Marine Fisheries Service, 2014b).

Pursuant to the ESA, activities that release military expended materials-munitions during testing activities under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and will have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA in that regard.

3.8.3.6.1.2 Impacts from Military Expended Materials – Munitions under Alternative 2

Impacts from Military Expended Materials – Munitions under Alternative 2 for Training Activities

The locations of training activities that expend non-explosive practice munitions and high-explosive munition fragments are the same under Alternatives 1 and 2. In addition, the number of non-explosive practice munitions expended annually and over five years would be identical under Alternatives 1 and 2. While the annual number of high-explosive munition fragments would not change under Alternative 2, there would be a very slight increase (approximately 0.001 percent) over five years. This fractional increase does not substantially increase the risk of ingestion impacts on sea turtles. Therefore, the analysis presented in Section 3.8.3.6.1.1 (Impacts from Military Expended Materials - Munitions under Alternative 1) for training activities would also apply to training activities proposed for Alternative 2.

Proposed training activities under Alternative 2 that expend munitions would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy training activities that expend munitions would occur year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Munitions that pose ingestion risk have no way of impacting the habitat types that comprise loggerhead turtle critical habitat (National Marine Fisheries Service, 2014b).

Pursuant to the ESA, activities that release military expended materials-munitions during training activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and will have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat.

Impacts from Military Expended Materials – Munitions under Alternative 2 for Testing Activities

The locations of testing activities that expend non-explosive practice munitions and high-explosive munition fragments would be identical under Alternatives 1 and 2. The numbers of non-explosive practice munitions (of ingestible size) during testing activities would be the same annually, but would increase by 2 percent over five years. In addition, the numbers of high-explosives resulting in fragments expended during testing activities would increase by 0.014 percent annually and by approximately 5 percent over five years. This increased use of munition-related military expended materials would be fractional and would not appreciably increase the potential for adverse ingestion impacts on sea turtles. Therefore, the analysis presented in Section 3.8.3.6.1.1 (Impacts from Military Expended Materials - Munitions under Alternative 1) for testing activities would also apply to testing activities proposed for Alternative 2.

Proposed testing activities under Alternative 2 that expend munitions would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita

Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy testing activities that expend munitions would occur year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Munitions that pose ingestion risk have no way of impacting the habitat types that comprise loggerhead turtle critical habitat (National Marine Fisheries Service, 2014b).

Pursuant to the ESA, activities that release military expended materials-munitions during testing activities under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and will have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA in that regard.

3.8.3.6.1.3 Impacts from Military Expended Materials-Munitions under the No Action Alternative

<u>Impacts from Military Expended Materials-Munitions under the No Action Alternative for Training and Testing Activities</u>

Under the No Action Alternative, the Navy would not conduct the proposed training or testing activities in the AFTT Study Area. Various ingestion stressors (e.g., military expended materials-munitions) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.8.3.6.2 Impacts from Military Expended Materials Other Than Munitions

Several different types of materials other than munitions are expended during training and testing activities in the AFTT Study Area. The following military expended materials other than munitions have the potential to be ingested by reptiles:

- target-related materials
- chaff (including fibers and end caps)
- flares (including end caps and compression pads/pistons)
- decelerators/parachutes (cloth, nylon, and metal weights)
- biodegradable polymer

Target-Related Materials

At-sea targets are usually remotely operated airborne, surface, or subsurface traveling units, most of which are designed to be recovered for reuse. If they are severely damaged or displaced, targets may sink before they can be retrieved. Expendable targets include air-launched decoys, marine markers (smoke floats), cardboard boxes, and 10-ft. diameter red balloons tethered by a sea anchor. Most target fragments would sink quickly in the sea. Floating material, such as Styrofoam, may be lost from target boats and remain at the surface for some time; however, during target recovery, personnel would collect as much floating debris and Styrofoam as possible. Sea turtles would be exposed to potential ingestion risk of target-related materials where these items are expended in offshore and inshore waters. American alligators may be exposed to target-related materials (specifically, marine markers) in waters near Port Canaveral, Florida, while diamondback terrapins may be exposed to target-related materials at Narragansett, Rhode Island; James River and tributaries, Virginia; York River, Virginia; and Lower Chesapeake Bay, Virginia (see Table 3.0-33).

Chaff

Chaff would only be expended over offshore areas; therefore, only sea turtles are analyzed for potential impacts of ingesting chaff. Chaff is an electronic countermeasure designed to reflect radar waves and obscure aircraft, vessels, and other equipment from radar tracking sources. Chaff is composed of an aluminum alloy coating on glass fibers of silicon dioxide (U.S. Air Force, 1997). It is released or dispensed in cartridges or projectiles that contain millions of chaff fibers. When deployed, a diffuse cloud of fibers undetectable to the human eye is formed. Chaff is a very light material that can remain suspended in air anywhere from 10 minutes to 10 hours and can travel considerable distances from its release point, depending on prevailing atmospheric conditions (Arfsten et al., 2002; U.S. Air Force, 1997). Doppler radar has tracked chaff plumes containing approximately 900 grams (g) of chaff drifting 200 mi. from the point of release, with the plume covering greater than 400 cubic miles (1,667 cubic kilometers) (Arfsten et al., 2002).

The chaff concentrations that sea turtles could be exposed to following release of multiple cartridges (e.g., following a single day of training) are difficult to accurately estimate because it depends on several unknown factors. First, specific release points are not recorded and tend to be random, and chaff dispersion in air depends on prevailing atmospheric conditions. After falling from the air, chaff fibers would be expected to float on the sea surface for some period, depending on wave and wind action. The fibers would be dispersed further by sea currents as they float and slowly sink toward the bottom. Chaff concentrations in benthic habitats following release of a single cartridge would be lower than the values noted in this section, based on dispersion by currents and the enormous dilution capacity of the receiving waters.

Several literature reviews and controlled experiments have indicated that chaff poses little risk, except at concentrations substantially higher than those that could reasonably occur from military training (Arfsten et al., 2002; U.S. Air Force, 1997). Nonetheless, some sea turtle species within the Study Area could be exposed to chaff through direct body contact and ingestion. Chemical alteration of water and sediment from decomposing chaff fibers is not expected to result in exposure. Based on the dispersion characteristics of chaff, it is likely that sea turtles would occasionally come in direct contact with chaff fibers while at the water's surface and while submerged, but such contact would be inconsequential. Chaff is similar to fine human hair (U.S. Air Force, 1997). Because of the flexibility and softness of chaff, external contact would not be expected to impact most wildlife (U.S. Air Force, 1997) and the fibers would quickly wash off shortly after contact. Given the properties of chaff, skin irritation is not expected to be a problem (U.S. Air Force, 1997). Arfsten et al. (2002) reviewed the potential effects of chaff inhalation on humans, livestock, and animals and concluded that the fibers are too large to be inhaled into the lung. The fibers are predicted to be deposited in the nose, mouth, or trachea and are either swallowed or expelled; however, these reviews did not specifically consider sea turtles.

Although chaff fibers are too small for sea turtles to confuse with prey and forage, there is some potential for chaff to be incidentally ingested along with other prey items, particularly if the chaff attaches to other floating marine debris. If ingested, chaff is not expected to impact sea turtles due to the low concentration that would be ingested and the small size of the fibers. While no similar studies to those discussed in Section 3.0.3.3.6.3 (Military Expended Materials Other Than Munitions) on the impacts of chaff have been conducted on sea turtles, they are also not likely to be impacted by incidental ingestion of chaff fibers. For instance, some sea turtles ingest spicules (small spines within the structure of a sponge) in the course of eating the sponges, without harm to their digestive system. Since chaff fibers are of similar composition and size as these spicules (U.S. Department of the Navy, 1999), ingestion of chaff should be inconsequential for sea turtles.

Chaff cartridge plastic end caps and pistons would also be released into the marine environment, where they would persist for long periods and could be ingested by sea turtles while initially floating on the surface and sinking through the water column. Chaff end caps and pistons would eventually sink in saltwater to the seafloor (Spargo, 2007), which reduces the likelihood of ingestion by sea turtles at the surface or in the water column. However, bottom-feeding sea turtles, such as green, hawksbill, Kemp's ridley, and loggerhead turtles, would be at increased risk if these items were deposited in potential benthic feeding areas and before these items would be encrusted or buried.

Flares

Flares and components of flares (e.g., o-rings, compression pads, plastic pistons) would be introduced in offshore areas and one inshore location (James River and tributaries, Virginia). Therefore, these items are analyzed for potential ingestion risk for sea turtles and diamondback terrapins. Flares are designed to burn completely. The only material that would enter the water would be a small, round, plastic compression pad or piston (0.45 to 4.1 g depending on flare type). The flare pads and pistons float in sea water.

An extensive literature review and controlled experiments conducted by the United States Air Force demonstrated that self-protection flare use poses little risk to the environment or animals (U.S. Air Force, 1997). For sea turtles and diamondback terrapins, these types of flares are large enough to not be considered an ingestion hazard. Nonetheless, sea turtles within the vicinity of flares could be exposed to light generated by the flares. Compression pads/pistons, o-rings and endcaps from flares would have the same impact on sea turtles and terrapins in inshore waters as discussed under chaff cartridges. It is unlikely that sea turtles or terrapins would be exposed to any chemicals that produce either flames or smoke since these components are consumed in their entirety during the burning process. Animals are unlikely to approach or get close enough to the flame to be exposed to any chemical components.

Decelerators/Parachutes

Decelerators/parachutes would only be expended in offshore waters; therefore, these items are only analyzed as potential ingestion risks for sea turtles.

As noted previously in Section 3.0.3.3.5.2 (Decelerators/Parachutes), decelerators/parachutes are classified into four different categories based on size: small, medium, large, and extra-large. The majority of expended decelerators/parachutes are in the small category. Decelerators/parachutes in the three remaining size categories (medium – up to 19 ft. in diameter, large – between 30 and 50 ft. in diameter, and extra-large – up to 80 ft.in diameter) are likely too big to be mistaken for prey items and ingested by a sea turtle.

The majority of decelerators/parachutes are weighted and by design must sink below the surface within five minutes of contact with the water. Once on the seafloor, decelerators/parachutes become flattened (Environmental Sciences Group, 2005). Ingestion of a small decelerator/parachute by a sea turtle at the surface or within the water column would be unlikely, since the decelerator/parachute would not be available for very long before it sinks. Once on the seafloor, if bottom currents are present, the canopy may temporarily billow and be available for potential ingestion by sea turtles with bottom-feeding habits.

Ingestion of a decelerator/parachute by a sea turtle at the surface or within the water column would be unlikely, since the decelerator/parachute would not be available for very long before it sinks. Once on the seafloor, if bottom currents are present, the canopy may temporarily billow and be available for potential ingestion by a sea turtle feeding on or near the seafloor. Conversely, the decelerator/ parachute could be buried by sediment in most soft bottom areas or colonized by attaching and encrusting organisms, which would further stabilize the material and reduce the potential for an ingestion risk. Some decelerators/parachutes may be too large to be a potential prey item for certain age classes (e.g., hatchlings and pre-recruitment juveniles), although degradation of the decelerator/ parachute may create smaller items that are potentially ingestible. The majority of these items (from sonobuoys), however, would be expended in deep offshore waters. Bottom-feeding sea turtles (e.g., green, hawksbill, Kemp's ridley, and loggerhead turtles) tend to forage in nearshore and coastal areas rather than offshore, where the majority of these decelerators/parachutes are used. Since these materials would most likely be expended in offshore waters too deep for benthic foraging, it would be unlikely for bottom foraging sea turtles to interact with these materials once they sink; therefore, unlikely that sea turtles would encounter decelerators/parachutes once they reach the seafloor.

Biodegradable Polymer

Biodegradable polymers would only be expended in offshore waters; therefore, these items are only analyzed as potential ingestion risks for sea turtles. As stated in Section 3.0.3.3.5.3 (Biodegradable Polymer) based on the constituents of the biodegradable polymer, it is anticipated that the material will breakdown into small pieces within a few days to weeks. The small pieces will breakdown further and dissolve into the water column within weeks to a few months and could potentially be incidentally ingested by sea turtles. Because the final products of the breakdown are all environmentally benign, the Navy does not expect the use biodegradable polymer to be an ingestion stressor for sea turtles; therefore, is not analyzed further.

3.8.3.6.2.1 Impacts from Military Expended Materials Other Than Munitions under Alternative 1

Impacts from Military Expended Materials Other Than Munitions under Alternative 1 for Training Activities

As presented in Section 3.0.3.3.6 (Ingestion Stressors) and Section 3.0.3.3.4.2 (Military Expended Materials), military expended materials other than munitions would be expended during offshore training activities within the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes as well as other areas outside the range complexes. In addition, training activities that expend other materials would occur within inshore waters including and surrounding Narragansett, Rhode Island; James River and tributaries, Virginia; York River, Virginia; Lower Chesapeake Bay, Virginia; and Port Canaveral, Florida.

Target-related material, chaff, flares, and decelerators/parachutes (and their subcomponents) have the potential to be ingested by a sea turtle, American alligator, or diamondback terrapin, although that is considered unlikely since most of these materials would quickly drop through the water column, settle on the seafloor, or in the case of biodegradable polymers, rapidly decay and not present an ingestion hazard. Some Styrofoam, plastic endcaps, chaff, and other small items may float for some time before sinking.

While the smaller items discussed here may pose a hazard to reptiles, as discussed for non-explosive practice munitions ingestion, the impacts of ingesting these forms of expended materials on reptiles would be minor because of the following factors:

- the limited geographic area where materials other than munitions are expended during a given event
- the limited period of time these military expended materials would remain in the water column
- the unlikely chance that a sea turtle might encounter and swallow these items on the seafloor, particularly given that many of these items would be expended over deep, offshore waters
- the limited types of military expended materials that would be expended in inshore waters where benthic feeding may occur in higher concentrations that overlap with activities
- the ability of reptiles to reject and not swallow non-food items incidentally ingested.

For sea turtles, the impacts of ingesting military expended materials other than munitions would be limited to cases where an individual sea turtle might eat an indigestible item too large to be passed through the gut. The sea turtle would not be preferentially attracted to these military expended materials, with the possible exception of decelerators/parachutes that may appear similar to the prey of some sea turtle species and life stages that feed on jellyfish and similar organisms. Post-hatchling loggerhead turtles have been found to feed on jellyfish and zooplankton (Browlow et al., 2016; Burkholder et al., 2004; Carr & Meylan, 1980; Richardson & McGillivary, 1991), and post-hatchling green turtles have been found to feed on comb jellies and gelatinous eggs (Salmon et al., 2004; Salmon et al., 2016). Late juvenile hawksbill turtles and Kemp's ridley turtles may also prey on jellyfish (Bjorndal, 1997; Frick et al., 1999; Marquez, 1994; Seney, 2016). Leatherback turtles predominately prey upon jellyfish (Wallace et al., 2015).

For the most part, these military expended materials would most likely only be incidentally ingested by individuals feeding on the bottom in the precise location where these items were deposited. Military expended materials other than munitions that would remain floating on the surface are too small to pose a risk of intestinal blockage to any sea turtle that happened to encounter it. Because leatherbacks of all age classes, and hatchlings and juveniles of green, hawksbill, Kemp's ridley, and loggerhead sea turtles are more likely to feed at or near the surface in the open ocean, they are more likely to encounter materials at the surface than other age classes of sea turtles that primarily feed along the seafloor. For example, the non-munitions material that floats in the water, such as flare pads and pistons, as well as some target-related materials that may not be recovered (e.g., Styrofoam) may pose an ingestion risk for these age classes and species given their feeding behavior and prey choice. Though green, hawksbill, Kemp's ridley, and loggerhead sea turtles are bottom-feeding species that generally recruit to and feed in nearshore waters once they reach the juvenile stage, they may occur in the open ocean during migrations.

For training activities occurring in the offshore waters, the species and age classes that have the potential to be impacted are hatchlings and pre-recruitment juveniles of all sea turtle species, and leatherback turtles of all age classes. Hatchlings and pre-recruitment juveniles of all sea turtle species may also occur in open-ocean habitats and be exposed to these activities; however, the likelihood of impact is lower for these age classes due to their occurrence at or near the water surface by concentrated *Sargassum* mats. Activities will not be initiated near concentrated *Sargassum* mats due to the possible presence of sea turtles (see Section 5.3, Procedural Mitigation to be Implemented). Non-munitions materials, with the exception of decelerators/parachutes since they are expended in deeper offshore waters, may pose a slight risk to juvenile, sub-adult, and adult loggerhead, green, and hawksbill turtles that have recruited to benthic foraging grounds, especially if non-munitions materials are expended in waters where the isobaths are not greater than the benthic foraging ability (dive depth), then these age classes and species could be at risk of potentially ingesting non-munitions materials. For example, hawksbills and loggerheads may forage in benthic habitats as deep as approximately 80 m and 200 m, respectively (Hochscheid, 2014). Juvenile sea turtles (e.g., green turtles) may rest and forage in waters as deep as approximately 30 m (Hochscheid, 2014). Sea turtles are expected to be highly dispersed in offshore waters. Repeated exposures to sea turtles are not anticipated as these offshore areas do not have resident animals year round. In offshore waters, the amount of military expended materials other than munitions that an individual sea turtle would encounter is generally low based on the patchy distribution of both the non-munitions and sea turtles.

Navy training activities involving military expended materials other than munitions in the inshore waters occur in several locations along the Atlantic coast, but fewer types of military materials (e.g., flares and target related materials) would be expended compared to the activities in the offshore areas (see Table 3.0-33). As stated above, target-related materials are recovered to the maximum extent practical, thereby decreasing the potential for ingestion by sea turtles. The highest concentration of non-munitions materials would be expended in the James River and tributaries in Virginia. Other locations include Boston, Massachusetts; Lower Chesapeake Bay, Virginia; Moorehead City, North Carolina; and Port Canaveral, Florida. For training activities occurring in inshore waters, juvenile, sub-adult, and adult loggerhead, green, Kemp's ridley, and hawksbill sea turtles that have recruited to benthic foraging grounds may be impacted. Sub-adult and adult leatherbacks that forage at the surface in coastal and sometimes estuarine waters may also be impacted. Most of the non-munitions materials expended in inshore waters consist of flares (see Table 3.0-33). Since the only material that would enter the water after the flare has burned would be small pads and pistons that float, this decreases the potential for ingestion by juvenile, sub-adult, and adult green, hawksbill, Kemp's ridley, and loggerhead turtles that feed on the bottom.

Based on the discussion presented above and in Section 3.8.3.6.2 (Impacts from Military Expended Materials Other Than Munitions), the likelihood that a sea turtle would encounter and subsequently ingest a non-munitions item associated with Navy training activities is considered low, and non-munitions are generally expected to cause an insignificant impact to sea turtles. Sublethal impacts due to ingestion of military expended materials other than munitions used in training activities may cause short-term or long-term disturbance to an individual turtle because (1) if a sea turtle were to incidentally ingest and swallow a decelerator/parachute, target fragment, chaff or flare component, it could potentially disrupt its feeding behavior or digestive processes; and (2) if the item is particularly large in proportion to the turtle ingesting it, the item could become permanently encapsulated by the stomach lining, with a rare chance that this could impede the turtle's ability to feed or take in nutrients. Potential impacts of exposure to these items may result in changes to an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment. However, decelerators/parachutes, target fragments, chaff, and flare components used in training activities are generally not expected to cause disturbance to sea turtles because (1) leatherbacks are more likely to forage further offshore than within range complexes, and other sea turtles (e.g., juvenile, sub-adult, and adult green, hawksbill, Kemp's ridley, and loggerhead turtles) primarily forage on the bottom in nearshore areas; (2) in some cases, a turtle would likely pass the item through its digestive tract and expel the item without impacting the individual permanently; and (3) chaff, if ingested, would occur in very low concentration and is similar to spicules, which sea turtles (species and life stages such as adult loggerheads that consume sponges and other organisms containing spicules) ingest without harm. For example, Schuyler et al. (2014) noted that less than 10 percent of sea turtles (out of a sample size of 454 turtles) that ingested a wide range of debris suffered mortality, and 4 percent of turtles necropsied were killed by plastics ingestion (out of a sample size of 1,106 necropsied turtles).

Potential impacts of exposure to non-munitions materials are not expected to result in substantial changes in an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment, and as such are not expected to result in population-level impacts for all sea turtle species.

American alligators would be exposed to potential ingestion risks of other materials expended at Port Canaveral, Florida. As stated above in Section 3.8.3.6 (Ingestion Stressors), American alligators are generalist predators, but may specialize in specific prey items depending on habitat, age class of the alligator, and behaviors specific to individual alligators. In inshore waters at Port Canaveral, Florida, marine markers would be the only other type of military expended material released. Marine markers would likely float on the water's surface or wash ashore in alligator habitats; however, potential ingestion of marine markers should be considered very low because these items do not resemble prey. In addition, there is a very low probability that American alligators foraging in estuarine habitats would encounter expended marine markers. Potential impacts of exposure to marine markers are not expected to result in substantial changes in an individual alligator's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment, and as such are not expected to result in population-level impacts for the American alligator.

Other materials expended in inshore waters would be released in areas potentially occupied by diamondback terrapins in waters surrounding Narragansett, Rhode Island; James River and tributaries, Virginia; York River, Virginia; Lower Chesapeake Bay, Virginia; and Port Canaveral, Florida. In inshore waters, training activities would concentrate other materials in estuarine areas that may potentially be used by terrapins while foraging for benthic prey items (e.g., crustaceans, molluscs) once expended materials sink, or when floating on the surface or suspended in the water column. There is a very low probability that diamondback terrapins foraging in estuarine habitats would encounter expended materials. Diamondback terrapins are believed to use visual cues for foraging for prey items; therefore, it is unlikely that a diamondback terrapin would mistake other materials for prey items. Potential impacts of exposure to other materials are not expected to result in substantial changes in an individual terrapin's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment, and as such are not expected to result in population-level impacts for the diamondback terrapin.

Proposed training activities under Alternative 1 that expend potentially ingestible non-munitions materials would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy training activities would expend potentially ingestible non-munitions materials year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Ingestion stressors introduced by military expended materials other than munitions have no way of impacting the physical and biological features that comprise loggerhead turtle critical habitat (National Marine Fisheries Service, 2014b).

Pursuant to the ESA, training activities that expend potentially ingestible non-munitions materials under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and would have no effect the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Military Expended Materials Other Than Munitions under Alternative 1 for Testing Activities

As presented in Section 3.0.3.3.6 (Ingestion Stressors) and Section 3.0.3.3.4.2 (Military Expended Materials), military expended materials other than munitions would be expended during testing activities within the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Gulf of Mexico, and Key West Range Complexes, as well as the Naval Undersea Warfare Center, Division Newport Testing Range; South Florida Ocean Measurement Facility Testing Range; and Naval Surface Warfare Center, Panama City Division Testing Range. The Virginia Capes and Jacksonville Range Complexes have the highest estimated numbers of non-munitions materials per year for testing activities. Testing activities using military expended materials other than munitions would not occur in inshore waters. Therefore, only sea turtles in offshore areas are analyzed for potential impacts from ingestion of other materials under Alternative 1 testing activities.

Target-related material, chaff, flares, and decelerators/parachutes (and their subcomponents) have the potential to be ingested by a sea turtle, although that is considered unlikely since most of these materials would quickly drop through the water column, settle on the seafloor, or in the case of biodegradable polymers, rapidly decay and not present an ingestion hazard. Some Styrofoam, plastic endcaps, chaff, and other small items may float for some time before sinking.

While the smaller items discussed here may pose a hazard to sea turtles, as discussed for non-explosive practice munitions ingestion, the impacts of ingesting these forms of expended materials on sea turtles would be minor because of the following factors:

- the limited geographic area where materials other than munitions are expended during a given event
- the limited period of time these military expended materials would remain in the water column
- the unlikely chance that a sea turtle might encounter and swallow these items on the seafloor, particularly given that many of these items would be expended over deep, offshore waters

The impacts of ingesting military expended materials other than munitions would be limited to cases where an individual sea turtle might eat an indigestible item too large to be passed through the gut. The sea turtle would not be preferentially attracted to these military expended materials, with the possible exception of decelerators/parachutes that may appear similar to the prey of some sea turtle species and life stages that feed on jellyfish and similar organisms. Post-hatchling loggerhead turtles have been found to feed on jellyfish and zooplankton (Browlow et al., 2016; Burkholder et al., 2004; Carr & Meylan, 1980; Richardson & McGillivary, 1991), and post-hatchling green turtles have been found to feed on comb jellies and gelatinous eggs (Salmon et al., 2004; Salmon et al., 2016). Late juvenile hawksbill turtles and Kemp's ridley turtles may also prey on jellyfish (Bjorndal, 1997; Frick et al., 1999; Marquez, 1994; Seney, 2016). Leatherback turtles predominately prey upon jellyfish (Wallace et al., 2015).

For the most part, these military expended materials would most likely only be incidentally ingested by individuals feeding on the bottom in the precise location where these items were deposited. Military expended materials other than munitions that would remain floating on the surface are too small to pose a risk of intestinal blockage to any sea turtle that happened to encounter it. Because leatherbacks of all age classes, and hatchlings and juveniles of green, hawksbill, Kemp's ridley, and loggerhead turtles are more likely to feed at or near the surface in the open ocean, they are more likely to encounter materials at the surface than other age classes of sea turtles that primarily feed along the seafloor. For example, the non-munitions material that floats in the water such as flare pads and pistons as well as some target-related materials that may not be recovered (e.g., Styrofoam) may pose an ingestion risk for these age classes and species given their feeding behavior and prey choice. Though green, hawksbill, Kemp's ridley, and loggerhead sea turtles are bottom-feeding species that generally recruit to and feed in nearshore waters once they reach the juvenile stage, they may occur in the open ocean during migrations.

For testing activities occurring in the offshore waters, the species and age classes that have the potential to be impacted are hatchlings and pre-recruitment juveniles of all sea turtle species, and leatherback turtles of all age classes. Hatchlings and pre-recruitment juveniles of all sea turtle species may also occur in open-ocean habitats and be exposed to these activities; however, the likelihood of impact is lower for these age classes due to their occurrence at or near the water surface by concentrated *Sargassum* mats. Activities will not be initiated near concentrated *Sargassum* mats due to the possible presence of sea turtles (see Section 5.3, Procedural Mitigation to be Implemented). Non-munitions materials, with the exception of decelerators/parachutes since they are expended in deeper offshore waters, may pose a slight risk to juvenile, sub-adult, and adult loggerhead, green, and hawksbill turtles that have recruited to benthic foraging grounds, especially if non-munitions materials are expended in waters where the isobaths are not greater than the benthic foraging ability (dive depth), then these age classes and species could be at risk of potentially ingesting non-munitions materials. For example, hawksbills and loggerheads may forage in benthic habitats as deep as approximately 80 m and 200 m, respectively (Hochscheid, 2014). Juvenile sea turtles (e.g., green turtles) may rest and forage in waters as deep as approximately 30 m (Hochscheid, 2014). Sea turtles are expected to be highly dispersed in offshore waters. Repeated exposures to sea turtles are not anticipated as these offshore areas do not have resident animals year round. In offshore waters, the amount of military expended materials other than munitions that an individual sea turtle would encounter is generally low based on the patchy distribution of both the non-munitions and sea turtles.

Based on the discussion presented above and in Section 3.8.3.6.2 (Impacts from Military Expended Materials Other Than Munitions), the likelihood that a sea turtle would encounter and subsequently ingest a non-munitions item associated with Navy training activities is considered low, and non-munitions are generally expected to cause an insignificant impact to sea turtles. Sublethal impacts due to ingestion of military expended materials other than munitions used in training activities may cause short-term or long-term disturbance to an individual turtle because (1) if a sea turtle were to incidentally ingest and swallow a decelerator/parachute, target fragment, chaff or flare component, it could potentially disrupt its feeding behavior or digestive processes; and (2) if the item is particularly large in proportion to the turtle ingesting it, the item could become permanently encapsulated by the stomach lining, with a rare chance that this could impede the turtle's ability to feed or take in nutrients. Potential impacts of exposure to these items may result in changes to an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment. However, decelerators/parachutes, target fragments, chaff, and flare components used in training activities are generally not expected to cause disturbance to sea turtles because (1) leatherbacks are more likely to forage further offshore than within range complexes, and other sea turtles (e.g., juvenile, sub-adult, and adult green, hawksbill, Kemp's ridley, and loggerhead turtles) primarily forage on the bottom in nearshore areas; (2) in some cases, a turtle would likely pass the item through its digestive tract and expel the item without impacting the individual permanently; and (3) chaff, if ingested, would occur in very low concentration and is similar to spicules, which sea turtles (species and life stages such as adult loggerheads that consume sponges and other organisms containing spicules) ingest without harm. For example, Schuyler et al. (2014) noted that less than 10 percent of sea turtles (out of a sample size of 454 turtles) that ingested a wide range of debris suffered mortality, and 4 percent of turtles necropsied were killed by plastics ingestion (out of a sample size of 1,106 necropsied turtles).

Potential impacts of exposure to non-munitions materials are not expected to result in substantial changes in an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment, and as such are not expected to result in population-level impacts for all sea turtle species.

Proposed testing activities under Alternative 1 that expend potentially ingestible non-munitions materials would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy testing activities would expend potentially ingestible non-munitions materials year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Ingestion stressors introduced by military expended materials other than munitions have no way of impacting the physical and biological features that comprise loggerhead turtle critical habitat (National Marine Fisheries Service, 2014b).

Pursuant to the ESA, testing activities that expend potentially ingestible non-munitions materials under Alternative 1 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and would have no effect the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA in that regard.

3.8.3.6.2.2 Impacts from Military Expended Materials Other Than Munitions under Alternative 2

Impacts from Military Expended Materials Other Than Munitions under Alternative 2 for Training Activities

As presented in Section 3.0.3.3.6 (Ingestion Stressors), and Section 3.0.3.3.4.2 (Military Expended Materials), the locations of training activities that expend military expended materials other than munitions would be identical under Alternatives 1 and 2. However, the total number of military expended materials other than munitions released throughout these locations would increase by 0.2 percent annually and by 0.2 percent over five years. The fractional increase in amount of military expended materials other than munitions would not substantially increase the potential for sea turtles to ingest these items. Therefore, the analysis presented in Section 3.8.3.6.2.1 (Impacts from Military Expended Materials Other Than Munitions under Alternative 1) for training activities would also apply to training activities proposed under Alternative 2 for sea turtles, American alligators, and diamondback terrapins.

Proposed training activities under Alternative 2 that expend potentially ingestible non-munitions materials would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or

American crocodile (Florida Bay). Navy training activities would expend potentially ingestible non-munitions materials year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Ingestion stressors introduced by military expended materials other than munitions have no way of impacting the physical and biological features that comprise loggerhead turtle critical habitat (National Marine Fisheries Service, 2014b).

Pursuant to the ESA, training activities that expend potentially ingestible non-munitions materials under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and would have no effect the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat.

Impacts from Military Expended Materials-Other Than Munitions under Alternative 2 for Testing Activities

As presented in Section 3.0.3.3.6 (Ingestion Stressors) and Section 3.0.3.3.4.2 (Military Expended Materials), the locations of testing activities that expend military expended materials other than munitions would be identical under Alternatives 1 and 2. However, the number of military expended materials other than munitions throughout these locations would increase by approximately 0.3 percent annually and by 1.2 percent over five years. The fractional increase in the amount of military expended materials other than munitions would not appreciably increase the potential for sea turtles to ingest these items. Therefore, the analysis presented in Section 3.8.3.6.2.1 (Impacts from Military Expended Materials Other Than Munitions under Alternative 1) for testing activities would also apply to testing activities proposed under Alternative 2.

Proposed testing activities under Alternative 2 that expend potentially ingestible non-munitions materials would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy testing activities would expend potentially ingestible non-munitions materials year round within the five critical habitat types for the loggerhead sea turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. Ingestion stressors introduced by military expended materials other than munitions have no way of impacting the physical and biological features that comprise loggerhead turtle critical habitat (National Marine Fisheries Service, 2014b).

Pursuant to the ESA, testing activities that expend potentially ingestible non-munitions materials under Alternative 2 may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and would have no effect the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat.

3.8.3.6.2.3 Impacts from Military Expended Materials Other Than Munitions under the No Action Alternative

Impacts from Military Expended Materials Other Than Munitions under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the proposed training or testing activities in the AFTT Study Area. Various ingestion stressors (e.g., military expended materials other than munitions) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.8.3.7 Secondary Stressors

This section analyzes potential impacts on sea turtles, crocodilians, and terrapins exposed to stressors indirectly through impacts on their habitat (sediment or water quality) or prey availability. For the purposes of this analysis, indirect impacts on reptiles via sediment or water quality that do not require trophic transfer (e.g., bioaccumulation) in order to be observed are considered here. Bioaccumulation considered previously in this document in the analysis of fishes (Section 3.6), invertebrates (Section 3.4), and marine habitats (Section 3.5) indicated minimal to no impacts on potential prey species of sea turtles, crocodilians, or terrapins. It is important to note that the terms “indirect” and “secondary” do not imply reduced severity of environmental consequences but instead describe how the impact may occur in an organism. The potential for impacts from all of these secondary stressors are discussed below.

Stressors from Navy training and testing activities that could pose indirect impacts on sea turtles via habitat or prey include: (1) explosives, (2) explosive byproducts and unexploded munitions, (3) metals, and (4) chemicals. Stressors from Navy training and testing activities that could pose indirect impacts on crocodilians or terrapins via habitat or prey include metals from training and testing activities in inshore waters. Analyses of the potential impacts on sediment and water quality are discussed in Section 3.2 (Sediments and Water Quality).

Explosives

As it pertains to sea turtles, underwater explosions could impact other species in the food web, including prey species that sea turtles feed upon and disrupt ecological relationships and conditions that would lead to decreased availability of forage. The impacts of explosions would differ depending on the type of prey species in the area of the blast. As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.6-1 through Table 2.6-4, training and testing activities resulting in underwater explosions will occur in the Study Area.

In addition to the physical effects of an underwater blast (e.g., injury or mortality from the blast pressure wave), prey might have behavioral reactions to underwater sound. For instance, prey species might exhibit a strong startle reaction to detonations that might include swimming to the surface or scattering away from the source. This startle and flight response is the most common secondary defense among animals (Mather, 2004). The abundance of prey species near the detonation point could be diminished for a short period before being repopulated by animals from adjacent waters (Berglind et al., 2009; Craig, 2001). Many sea turtle prey items, such as jellyfish, sponges, and molluscs have limited mobility and ability to react to pressure waves; therefore, mobile prey species for sea turtles would be less affected because of their ability to respond to other stressors preceding an underwater blast (e.g., vessel noise or visual cues). Any of these scenarios would be temporary, only occurring during activities involving explosives, and no lasting effect on prey availability or the pelagic food web would be expected. For example, if prey were removed from an area resulting from a stressor introduced by a training or testing activity, prey species would be expected to recolonize or recruit rapidly in the area because there would be little or no permanent change to the habitat.

The Navy will implement mitigation (e.g., not conducting gunnery activities within a specified distance of shallow-water coral reefs) to avoid potential impacts from explosives and physical disturbance and strike stressors on seafloor resources in mitigation areas throughout the Study Area (see Section 5.4.1, Mitigation Areas for Seafloor Resources). This mitigation will consequently help avoid or reduce potential impacts from explosives on sea turtle prey species that inhabit shallow-water coral reefs, live hard bottom, artificial reefs, submerged aquatic vegetation, and shipwrecks.

Explosion Byproducts and Unexploded Munitions

High-order explosions consume most of the explosive material, creating typical combustion products. In the case of Royal Demolition Explosive, also known as cyclonite and hexogen, 98 percent of the byproducts are common seawater constituents, and the remainder is rapidly diluted below threshold effect level (Section 3.2, Sediments and Water Quality). Explosion byproducts associated with high-order detonations present no indirect stressors to sea turtles through sediment or water. Furthermore, most explosions occur in depths exceeding that which normally support seagrass beds and coral reefs, areas that are commonly used by green and hawksbill sea turtles, respectively. For example, most detonations would occur in waters greater than 200 ft. in depth, and greater than 3 NM from shore, although mine warfare, demolition, and some testing detonations would occur in shallow water close to shore. These low-order detonations and unexploded munitions present elevated likelihood of secondary impacts on sea turtles.

Deposition of undetonated explosive materials into the marine environment can be reasonably well estimated by the known failure and low-order detonation rates of high-explosives (Section 3.2, Sediments and Water Quality, Table 3.2-7). While it is remotely possible for sea turtles to come into contact with an undetonated explosive, to have contact with unexploded materials in the sediment or water, and or to ingest unexploded materials in sediments, it is very unlikely.

Indirect impacts of explosives and unexploded munitions to sea turtles via sediment contamination is possible only if a sea turtle ingested the sediment. Degradation of explosives proceeds through several pathways, as discussed in Section 3.2.3.1 (Explosives and Explosives Byproducts). Degradation products of Royal Demolition Explosive are not toxic to marine organisms at realistic exposure levels (Rosen & Lotufo, 2010). Relatively low solubility of most explosives and their degradation products means that concentrations of these contaminants in the marine environment are relatively low and readily diluted. Furthermore, while explosives and their degradation products were detectable in marine sediment approximately 6 to 12 in. away from degrading munitions, the concentrations of these compounds were not statistically distinguishable from background beyond 3 to 6 ft. from the degrading munitions (Section 3.2.3.1, Explosives and Explosives Byproducts). Taken together, it is possible that sea turtles could be exposed to degrading explosives, but it would be within a very small radius of the explosive (1 to 6 ft.). Juvenile, sub-adult, and adult green, hawksbill, Kemp's ridley, and loggerhead sea turtles are the only age classes and species in the Study Area that might routinely ingest sediments while bottom feeding; however, feeding would most likely not occur in deep water areas (greater than 100 m) where unexploded materials are more likely to occur.

A series of studies of a World War II munitions disposal site off Hawaii have demonstrated only minimal concentrations of degradation products were detected in the adjacent sediments and that there was no detectable uptake in sampled organisms living on or in proximity to the site (Briggs et al., 2016; Edwards et al., 2016; Hawaii Undersea Military Munitions Assessment, 2010; Kelley et al., 2016; Koide et al., 2016).A series of research efforts focused on World War II underwater munitions disposal sites in Hawaii (Briggs et al., 2016; Edwards et al., 2016; Hawaii Undersea Military Munitions Assessment, 2010; Kelley et al., 2016; Koide et al., 2016) and an intensively used live fire range in the Mariana Islands Smith and Marx (2016) provide information in regard to the impacts of undetonated materials and unexploded munitions on marine life. Section 3.2.3.1 (Explosives and Explosives Byproducts) and Section 3.2.3.3 (Metals) contains a summary of this literature which investigated water and sediment quality impacts, on a localized scale, from munitions ocean disposal sites and ocean disposed dredge spoils sites. Findings from these studies indicate that there were no adverse impacts on the local ecology from the presence of degrading munitions and there was no bioaccumulation of munitions-related chemicals in local marine species.

The island of Farallon De Medinilla (in the Mariana Islands) has been used as a target area since 1971. Between 1997 and 2012, there were 14 underwater scientific survey investigations around the island providing a long-term look at potential impacts on the marine life from training and testing involving the use of munitions (Smith & Marx, 2016). Munitions use has included high-explosive rounds from gunfire, high-explosives bombs by Navy aircraft and U.S. Air Force B-52s, in addition to the expenditure of inert rounds and non-explosive practice bombs. Marine life assessed during these surveys included algae, corals, benthic invertebrates, sharks, rays, and bony fishes, and sea turtles. The investigators found no evidence over the 16-year period, that the condition of the biological resources had been adversely impacted to a significant degree by the training activities (Smith & Marx, 2016). Furthermore, they found that the health, abundance, and biomass of fishes, corals and other marine resources were comparable to or superior to those in similar habitats at other locations within the Mariana Archipelago.

These findings are consistent with other assessments such as that done for the Potomac River Test Range at Dahlgren, Virginia which was established in 1918 and is the nation’s largest fully instrumented, over-the-water gun-firing range. Munitions tested at Naval Surface Warfare Center, Dahlgren have included rounds from small-caliber guns up to the Navy’s largest (16-in. guns), bombs, rockets, mortars, grenades, mines, depth charges, and torpedoes (U.S. Department of the Navy, 2013). Results from the assessment indicate that munitions expended at Naval Surface Warfare Center, Dahlgren have not contributed to significant concentrations of metals to the Potomac River water and sediments given those contributions are orders of magnitude less than concentrations already present in the Potomac River from natural and manmade sources (U.S. Department of the Navy, 2013).

The concentration of munitions/explosions, expended material, or devices in any one location in the AFTT Study Area would be a small fraction of that from a World War II dump site, or a target island used for 45 years, or a water range in a river used for almost 100 years. Based on findings from much more intensively used locations, the water quality effects from the use of munitions, expended material, or devices resulting from any of the proposed actions would be negligible by comparison. As a result, explosion by-products and unexploded munitions would have no meaningful effect on water quality and would therefore not constitute a secondary indirect stressor for sea turtles.

Metals

Metals are introduced into seawater and sediments as a result of training and testing activities involving ship hulks, targets, munitions, and other military expended materials (Section 3.2.3.3, Metals) (Environmental Sciences Group, 2005). Some metals bioaccumulate and physiological impacts begin to occur only after several trophic transfers concentrate the toxic metals (Section 3.5, Habitats, and Chapter 4, Cumulative Impacts). Evidence from a number of studies (Briggs et al., 2016; Koide et al., 2016) indicate metal contamination is very localized and that bioaccumulation resulting from munitions cannot be demonstrated. Specifically, in sampled marine life living on or around munitions on the seafloor, metal concentrations could not be definitively linked to the munitions since comparison of metals in sediment next to munitions show relatively little difference in comparison to other “clean” marine sediments used as a control/reference (Koide et al., 2015). Research has demonstrated that some smaller marine organisms are attracted to metal munitions as a hard substrate for colonization or as shelter (Smith & Marx, 2016). Although this would likely increase prey availability for some benthic foraging sea turtles that feed on molluscs (e.g., loggerheads), the relatively low density of metals deposited by training and testing activities compared to concentrated dump and range sites would not likely substantively benefit sea turtles. Inshore waters, which would receive small-caliber shells from training activities have the potential to be deposited in substrates in estuaries used by some sea turtles (in particular Kemp's ridley, loggerhead, and green sea turtles), crocodilians, and terrapins; and riverine habitats where crocodilians and terrapins would be expected to occur. As with other studies discussed above, leaching of metals contained in shell casings would be expected to be localized in sediments with little opportunity for bioaccumulation into the food web that would impact crocodilian species or terrapins.

Chemicals

Several Navy training and testing activities introduce chemicals into the marine environment that are potentially harmful in higher concentrations; however, rapid dilution would occur and toxic concentrations are unlikely to be encountered. Chemicals introduced are principally from flares and propellants for missiles and torpedoes. Properly functioning flares, missiles, and torpedoes combust most of their propellants, leaving benign or readily diluted soluble combustion byproducts (e.g., hydrogen cyanide). Operational failures may allow propellants and their degradation products to be released into the marine environment. Flares and missile that operationally fail may release perchlorate, which is highly soluble in water, persistent, and impacts metabolic processes in many plants and animals if in sufficient concentration. Such concentrations are not likely to persist in the ocean. Research has demonstrated that perchlorate did not bioconcentrate or bioaccumulate, which was consistent with the expectations for a water soluble compound (Furin et al., 2013). Perchlorate from failed expendable items is therefore unlikely to compromise water quality to that point that it would act as a secondary stressor to sea turtles. It should also be noted that chemicals in the marine environment as a result of Navy training and testing activities would not occur in isolation and are typically associated with military expended materials that release the chemicals while in operation. Because sea turtles' avoidance of an expended flare, missile, or torpedo in the water is almost certain (because of other ques such as visual and noise disturbance), it would further reduce the potential for introduced chemicals to act as a secondary stressor. Avoidance is likely because expending these items would be accompanied by other visual ques or noise disturbances.

3.8.3.7.1 Impacts on Habitat

As presented above in Section 3.8.3.7 (Secondary Stressors), Navy activities that introduce explosive byproducts and unexploded munitions, metals, and chemicals into the marine environment have not demonstrated long-term impacts on sediment and water quality. Explosive byproducts and unexploded munitions from ongoing Navy activities have not resulted in water quality impacts, and the likelihood of sea turtles, crocodilians, or terrapins being in contact with sediments contaminated from degrading explosives is low, given the small radius of impact around the location of the explosive. Furthermore, there is no evidence of bioconcentration or bioaccumulation of chemicals introduced by Navy activities that would alter water quality to an extent that would result in overall habitat degradation for sea turtles, crocodilians, or terrapins.

As stated previously, most detonations would occur in waters greater than 200 ft. in depth, and greater than 3 NM from shore, although mine warfare, demolition, and some testing detonations would occur in shallow water close to shore. In deep waters, explosions would not likely remove habitat for sea turtles because the explosion would not be on or proximate to the sea floor. These habitats include corals, seagrass beds, and other benthic habitats that are used by juvenile and adult sea turtle species, e.g., green and hawksbill turtles. Metals are introduced into the water and sediments from multiple types of military expended materials. Available research indicates metal contamination is very localized and that bioaccumulation resulting from munitions would not occur. Several Navy training and testing activities introduce chemicals into the marine environment that are potentially harmful in concentration; however, through rapid dilution, toxic concentrations are unlikely to be encountered by sea turtles, crocodilians, and terrapins. In near shore waters, explosions would typically occur in the same locations, limiting the removal of habitat to previously disturbed areas. Therefore, habitat loss from training and testing activities that use explosions would not substantially remove habitats available to sea turtles, crocodilians, or terrapins and not impact individuals or populations.

Secondary stressors from Navy training and testing activities in the Study Area are not expected to result in substantial changes in an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment, and as such are not expected to result in population-level impacts for all sea turtle species, crocodilians, and terrapins.

Proposed training and testing activities that would introduce secondary stressors (potentially impacting habitats) would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy training and testing activities would introduce secondary stressors (that may impact habitats) year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. In nearshore waters, explosions would typically occur in the same locations, limiting the removal of habitat to previously disturbed areas. In offshore areas where most explosions would occur, the Navy would not initiate activities near concentrated *Sargassum* mats (see Section 5.3, Procedural Mitigation to be Implemented); therefore, developmental habitat for hatchlings and pre-recruitment juveniles of all sea turtle species would not be affected. Explosion byproducts, metals, and chemicals from training and testing activities, as discussed above, induce very localized or short-term impacts to water quality within the water column. Activities that introduce secondary stressors would occur over wide areas and in sufficiently low frequency as to not impact the physical and biological features that comprise loggerhead critical habitat.

Pursuant to the ESA, Navy training and testing activities would introduce secondary stressors with potential impacts on habitats that may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and would have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA in that regard, for training and testing activities described under Alternative 1.

3.8.3.7.2 Impacts on Prey Availability

As presented above in Section 3.8.3.7 (Secondary Stressors), Navy activities that introduce explosives, metals, and chemicals into the marine environment have not demonstrated long-term impacts on prey availability for sea turtles, crocodilians, or terrapins. Bioaccumulation of metals from munitions in prey species has not been demonstrated and no effects to prey availability from metals and chemicals are known to occur. Bioaccumulation of metals from munitions in prey species has not been demonstrated, and no effects to prey availability from metals and chemicals are known to occur. In-water explosions have the potential to injure or kill prey species that reptiles feed on within a small area affected by the blast; however, impacts would not substantially impact prey availability for sea turtles. Training and testing activities in the Study Area would be unlikely to impact coral reefs (a direct or indirect source of prey and forage items for juvenile, sub-adult, and adult hawksbill turtles) because the Navy implements measures within mitigation areas for shallow-water coral reefs. Also, activities are not initiated near concentrated *Sargassum* mats, where hatchlings and pre-recruitment juvenile sea turtle prey is found, due to the possible presence of sea turtles (see Section 5.3, Procedural Mitigation to be Implemented). These mitigation measures would continue under both Alternative 1 and Alternative 2. Activities that involve the use of explosives typically occur at depths that exceed areas that support seagrass beds for foraging juvenile, sub-adult, and adult green turtles. For inshore training and testing activities, impacts on prey availability for crocodilians and terrapins, if they occurred, would not likely be measureable because of the types of activities that would occur in inshore training and testing locations, and because of the generalist diet of crocodilians and terrapins.

Secondary stressors from Navy training and testing activities in the Study Area that may influence prey availability are not expected to result in substantial changes in an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment, and as such are not expected to result in population-level impacts for all sea turtle species, crocodilians, or terrapins.

Proposed training and testing activities that would introduce secondary stressors (potentially impacting prey availability) would not occur in designated critical habitat for the green sea turtle (Culebra Island), hawksbill sea turtle (Mona Island and Monita Island), leatherback sea turtle (St. Croix Island), or American crocodile (Florida Bay). Navy training and testing activities would introduce secondary stressors (that may influence prey availability) year round within the five critical habitat types for the loggerhead turtle. See Section 3.8.2.2.4.1 (Status and Management) for a description of these habitat types and supporting physical and biological factors. In nearshore waters, explosions would typically occur in the same locations, limiting the removal of habitat to previously disturbed areas. In offshore areas where most explosions would occur, the Navy would not initiate activities near concentrated *Sargassum* mats (see Section 5.3, Procedural Mitigation to be Implemented); therefore, developmental habitat for hatchlings and pre-recruitment juveniles of all sea turtle species would not be affected. Explosion byproducts, metals, and chemicals from training and testing activities, as discussed above, induce very localized or short-term impacts to water quality within the water column. Activities that introduce secondary stressors would occur over wide areas and in sufficiently low frequency as to not impact the physical and biological features that comprise loggerhead critical habitat.

Pursuant to the ESA, Navy training and testing activities would introduce secondary stressors influencing prey availability that may affect ESA-listed green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; and would have no effect on the American crocodile. There would be no effect on green, hawksbill, leatherback, or loggerhead sea turtle critical habitat; and no effect on American crocodile critical habitat. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA in that regard, for training and testing activities described under Alternative 1.

3.8.4 Summary of Potential Impacts on Reptiles

3.8.4.1 Combined Impacts of All Stressors under Alternative 1

As described in Section 3.0.3.5 (Resource-Specific Impacts Analysis for Multiple Stressors), this section evaluates the potential for combined impacts of all the stressors from the proposed action. The analysis and conclusions for the potential impacts from each of the individual stressors are discussed in Sections 3.8.3.1 (Acoustic Stressors) through 3.8.3.6 (Ingestion Stressors) and, for ESA-listed species, summarized in Section 3.8.4.4 (Endangered Species Act Determinations). Stressors associated with Navy training and testing activities do not typically occur in isolation but rather occur in some combination. For example, mine neutralization activities include elements of acoustic, physical disturbance and strike, entanglement, ingestion, and secondary stressors that are all coincident in space and time. An analysis of the combined impacts of all stressors considers the potential consequences of additive stressors and synergistic stressors, as described below. This analysis makes the reasonable assumption that the majority of exposures to stressors are non-lethal, and instead focuses on consequences potentially impacting sea turtle, crocodilian, or terrapin fitness (e.g., physiology, behavior, reproductive potential).

Additive Stressors–There are generally two ways that a sea turtle, crocodilian, or terrapin could be exposed to multiple additive stressors. The first would be if an animal were exposed to multiple sources of stress from a single event or activity within a single testing or training event (e.g., a mine warfare event may include the use of a sound source and a vessel). For crocodilians and terrapins, multiple additive stressors would likely be limited to vessel transits in shallow waters and sound sources, or for American alligators and terrapins, weapons firing noise and vessels; because of the limited number of additive stressors that crocodilians and terrapins would likely experience, only sea turtles are addressed further in this section.

The potential for a combination of these impacts from a single activity would depend on the range to effects of each of the stressors and the response or lack of response to that stressor. Most of the activities proposed under Alternative 1 generally involve the use of moving platforms (e.g., ships, torpedoes, and aircraft) that may produce one or more stressors; therefore, it is likely that if a sea turtle were within the potential impact range of those activities, it may be impacted by multiple stressors simultaneously. Individual stressors that would otherwise have minimal to no impact, may combine to have a measurable response. However, due to the wide dispersion of stressors, speed of the platforms, general dynamic movement of many training and testing activities, and behavioral avoidance exhibited by sea turtles, it is very unlikely that a sea turtle would remain in the potential impact range of multiple sources or sequential exercises. Exposure to multiple stressors is more likely to occur at an instrumented range where training and testing using multiple platforms may be concentrated during a particular event, or in inshore waters where sea turtles reside. In such cases involving a relatively small area on an instrumented range, a behavioral reaction resulting in avoidance of the immediate vicinity of the activity would reduce the likelihood of exposure to additional stressors. Nevertheless, the majority of the proposed activities in offshore areas are unit-level training and small testing activities which are conducted in the open ocean. Unit level exercises occur over a small spatial scale (one to a few square miles) and with few participants (usually one or two vessels) or short duration (the order of a few hours or less). In inshore waters, however, exposure to multiple stressors is likely because of the close proximity of stressors and higher numbers of sea turtles.

Secondly, a sea turtle could be exposed to multiple training and testing activities over the course of its life, however, training and testing activities are generally separated in space and time in such a way that it would be unlikely that any individual sea turtle would be exposed to stressors from multiple activities within a short timeframe. However, sea turtles with a home range intersecting an area of concentrated Navy activity have elevated exposure risks relative to sea turtles that simply transit the area through a migratory corridor. This limited potential for exposure of individuals is not anticipated to impact populations.

Synergistic Stressors–Multiple stressors may also have synergistic effects. For example, sea turtles that react to a sound source (behavioral response) or experience injury from acoustic stressors could be more susceptible to physical strike and disturbance stressors via a decreased ability to detect and avoid threats. Sea turtles that experience behavioral and physiological consequences of ingestion stressors could be more susceptible to entanglement and physical strike stressors via malnourishment and disorientation. Similarly, sea turtles that may be weakened by disease (e.g., fibropapillomatosis) or other factors that are not associated with Navy training and testing activities may be more susceptible to stressors analyzed in this EIS/OEIS. These interactions are speculative, and without data on the combination of multiple Navy stressors, the synergistic impacts from the combination of Navy stressors are difficult to predict in any meaningful way. Research and monitoring efforts have included before, during, and after-event observations and surveys, data collection through conducting long-term studies in areas of Navy activity, occurrence surveys over large geographic areas, biopsy of animals occurring in areas of Navy activity, and tagging studies where animals are exposed to Navy stressors. These efforts are intended to contribute to the overall understanding of what impacts may be occurring overall to animals in these areas.

Crocodilians and terrapins in inshore training and testing locations may experience a smaller array of additive and synergistic stressors relative to sea turtles in offshore locations. However, the stressors that could simultaneously occur or quickly follow each other may contribute to major risk factors for these species. For example, a major risk factor for crocodilians and terrapins is recreational boating, which may present the same risk factors as small boat movements associated with military training and testing activities. How crocodilians and terrapins may be at higher risk from other synergistic stressors is speculative. As with sea turtles, the additive and synergistic stressor impacts on crocodilians and terrapins from the combination of Navy stressors is difficult to predict in any meaningful way.

3.8.4.2 Combined Impacts of All Stressors under Alternative 2

Training and testing activities proposed under Alternative 2 would be an increase over what is proposed for Alternative 1. However, this increase is not expected to substantially increase the potential for impacts over what is analyzed for Alternative 1. The analysis presented in Section 3.8.4.1 (Combined Impacts of All Stressors under Alternative 1) would similarly apply to Alternative 2. The combined impacts of all stressors for training and testing activities under Alternative 2 are not expected to have deleterious impacts on the fitness of any individuals or long-term consequences to populations of sea turtles, crocodilians, or terrapins.

3.8.4.3 Combined Impacts of All Stressors under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various stressors would not be introduced into the marine environment, and there would be no combined impact of multiple stressors on sea turtles, crocodilians, or terrapins. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.8.5 Endangered Species Act Determinations

Administration of ESA obligations associated with sea turtles are shared between NMFS and USFWS, depending on life stage and specific location of the sea turtle. NMFS has jurisdiction over sea turtles in the marine environment, and USFWS has jurisdiction over sea turtles on land. The Navy has consulted with NMFS on its determination of effect on the potential impacts of the Proposed Action. Because no activities analyzed in this EIS/OEIS occur on land within sea turtle nesting areas, consultation with

USFWS is not required for sea turtles. American crocodiles are managed under the jurisdiction of USFWS; therefore, the Navy has consulted with USFWS for the proposed activities considered in this EIS/OEIS as required by section 7(a)(2) of the ESA.

Pursuant to the ESA, the Navy has concluded training and testing activities may affect the green sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, loggerhead sea turtle, leatherback sea turtle, and American crocodile. The Navy has also concluded that training and testing activities may affect designated critical habitat for the loggerhead sea turtle; and have no effect on designated critical habitat for the green sea turtle, hawksbill sea turtle, leatherback sea turtle, and American crocodile. The Navy has consulted with NMFS and USFWS as required by section 7(a)(2) of the ESA in that regard. The Navy's summary of effects determinations for each ESA-listed species is shown in Table 3.8-11. NMFS and USFWS concurred with all Navy determinations on their respective species.

Table 3.8-11: Summary of ESA-Effects Determinations for Reptiles (Alternative 1)

Species	Designation Unit	Effect Determinations by Stressor																	
		Acoustic						Explo-sives	Energy		Physical Disturbance and Strike				Entanglement			Ingestion	
		Sonar and Other Transducers	Air Guns	Pile Driving	Vessel Noise	Aircraft Noise	Weapons Noise	Explosives	In-water Electromagnetic Devices	High-energy Lasers	Vessels	In-water Devices	Military Expended Materials	Seafloor Devices	Wires and Cables	Decelerators/Parachutes	Biodegradable Polymer	Military Expended Materials - Munitions	Military Expended Materials - Other Than Munitions
Training Activities																			
American crocodile	Throughout range	NE	N/A	NE	NLAA	NLAA	NE	NLAA	NE	NE	NE	NE	NE	NE	NE	NE	N/A	NE	NE
	Critical habitat	NE	N/A	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	N/A	NE	NE
Green turtle	North Atlantic DPS	NLAA	N/A	NLAA	NLAA	NLAA	NLAA	LAA	NLAA	NLAA	LAA	NLAA	NLAA	NLAA	NLAA	LAA	N/A	NLAA	NLAA
	Critical habitat	NE	N/A	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	N/A	NE	NE
Hawksbill turtle	Throughout range	NLAA	N/A	NLAA	NLAA	NLAA	NLAA	LAA	NLAA	NLAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	N/A	NLAA	NLAA
	Critical habitat	NE	N/A	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	N/A	NE	NE
Kemp's ridley turtle	Throughout range	NLAA	N/A	NLAA	NLAA	NLAA	NLAA	LAA	NLAA	NLAA	LAA	NLAA	NLAA	NLAA	NLAA	LAA	N/A	NLAA	NLAA
Leatherback turtle	Throughout range	NLAA	N/A	NLAA	NLAA	NLAA	NLAA	LAA	NLAA	NLAA	LAA	NLAA	NLAA	NLAA	NLAA	LAA	N/A	NLAA	NLAA
	Critical habitat	NE	N/A	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	N/A	NE	NE
Loggerhead turtle	NW Atlantic Ocean DPS	NLAA	N/A	LAA	NLAA	NLAA	NLAA	LAA	NLAA	NLAA	LAA	NLAA	NLAA	NLAA	NLAA	LAA	N/A	NLAA	NLAA
	Critical habitat	NLAA	N/A	NE	NLAA	NE	NLAA	NLAA	NE	NE	NE	NE	NE	NE	NE	NE	N/A	NE	NE

Table 3.8-11: Summary of ESA-Effects Determinations for Reptiles (Alternative 1) (continued)

Species	Designation Unit	Effect Determinations by Stressor																	
		Acoustic						Explo-sives	Energy		Physical Disturbance and Strike				Entanglement			Ingestion	
		Sonar and Other Transducers	Air Guns	Pile Driving	Vessel Noise	Aircraft Noise	Weapons Noise	Explosives	In-water Electromagnetic Devices	High-energy Lasers	Vessels	In-water Devices	Military Expended Materials	Seafloor Devices	Wires and Cables	Decelerators/Parachutes	Biodegradable Polymer	Military Expended Materials - Munitions	Military Expended Materials - Other Than Munitions
Testing Activities																			
American crocodile	Throughout range	NE	NE	N/A	NLAA	NLAA	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	Critical habitat	NE	NE	N/A	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Green turtle	North Atlantic DPS	NLAA	NLAA	N/A	NLAA	NLAA	NLAA	LAA	NLAA	NLAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
	Critical habitat	NE	NE	N/A	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Hawksbill turtle	Throughout range	NLAA	NLAA	N/A	NLAA	NLAA	NLAA	LAA	NLAA	NLAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
	Critical habitat	NE	NE	N/A	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Kemp's ridley turtle	Throughout range	LAA	NLAA	N/A	NLAA	NLAA	NLAA	LAA	NLAA	NLAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Leatherback turtle	Throughout range	LAA	NLAA	N/A	NLAA	NLAA	NLAA	LAA	NLAA	NLAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
	Critical habitat	NE	NE	N/A	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Loggerhead turtle	NW Atlantic Ocean DPS	LAA	LAA	N/A	NLAA	NLAA	NLAA	LAA	NLAA	NLAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
	Critical habitat	NLAA	NE	N/A	NLAA	NE	NLAA	NLAA	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

Note: NW = Northwest; DPS = Distinct Population Segment; NE = no effect; NLAA = may effect, not likely to adversely affect; LAA = may effect, likely to adversely affect; N/A = not applicable, activity related to the stressor does not occur during specified training or testing events (e.g., there are no testing activities that involve the use of pile driving).

This page intentionally left blank.

References

Andrady, A. L. (2011). Microplastics in the marine environment. *Marine Pollution Bulletin, 62*, 1595–1605.

Arendt, M. D., J. A. Schwenter, A. L. Segars, J. I. Byrd, P. P. Maier, J. D. Whitaker, D. W. Owens, G. Blanvillain, J. M. Quattro, and M. A. Roberts. (2012). Catch rates and demographics of loggerhead sea turtles (*Caretta caretta*) captured from the Charleston, South Carolina, shipping channel during the period of mandatory use of turtle excluder devices (TEDs). *Fishery Bulletin, 110*(1), 98–109.

Arfsten, D. P., C. L. Wilson, and B. J. Spargo. (2002). Radio frequency chaff: The effects of its use in training on the environment. *Ecotoxicology and Environmental Safety, 53*, 1–11.

Arroyo-Arce, S., I. Thomson, E. Harrison, S. Wilmott, and G. Baker. (2017). First record of jaguar (*Panthera onca*) predation on a loggerhead sea turtle (*Caretta caretta*) in Tortuguero National Park, Costa Rica. *Herpetology Notes, 10*, 17–18.

Avens, L. (2003). Use of multiple orientation cues by juvenile loggerhead sea turtles *Caretta caretta*. *The Journal of Experimental Biology, 206*(23), 4317–4325.

Balazs, G. H. (1986). Fibropapillomas in Hawaiian green turtles. *Marine Turtle Newsletter, 39*, 1–3.

Balazs, G. H., P. Craig, B. R. Winton, and R. K. Miya. (1994). *Satellite telemetry of green turtles nesting at French Frigate Shoals, Hawaii, and Rose Atoll, American Samoa.* Paper presented at the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation, Hilton Head, SC.

Barco, S., and G. G. Lockhart. (2015). *Turtle Tagging and Tracking in Chesapeake Bay and Coastal Waters of Virginia: 2014 Annual Progress Report. Draft Report* (Contract No. N62470-10-D-3011, Task Orders 41 and 50, issued to HDR Inc.). Norfolk, VA Naval Facilities Engineering Command Atlantic.

Barco, S., M. Law, B. Drummond, H. Koopman, C. Trapani, S. Reinheimer, S. Rose, W. M. Swingle, and A. Williard. (2016). Loggerhead turtles killed by vessel and fishery interaction in Virginia, USA, are healthy prior to death. *Marine Ecology Progess Series, 555*, 221–234.

Bartol, S. M., J. A. Musick, and M. L. Lenhardt. (1999). Auditory evoked potentials of the loggerhead sea turtle (*Caretta caretta*). *Copeia, 1999*(3), 836–840.

Bartol, S. M., and D. R. Ketten. (2006). *Turtle and Tuna Hearing* (NOAA Technical Memorandum NMFS-PIFSC-7). Honolulu, HI: Pacific Islands Fisheries Science Center.

Basile, E. R., H. W. Avery, W. F. Bien, and J. M. Keller. (2011). Diamondback terrapins as indicator species of persistent organic pollutants: Using Barnegat Bay, New Jersey as a case study. *Chemosphere, 82*(1), 137–144.

Becking, L. E., T. C. J. M. van Bussel, A. O. Debrot, and M. J. A. Christianen. (2014). First record of a Caribbean green turtle (*Chelonia mydas*) grazing on invasive seagrass (*Halophila stipulacea*). *Caribbean Journal of Science, 48*(2–3), 162–163.

Benson, S. R., K. A. Forney, J. T. Harvey, J. V. Carretta, and P. H. Dutton. (2007). Abundance, distribution, and habitat of leatherback turtles (*Dermochelys coriacea*) off California, 1990–2003. *Fishery Bulletin, 105*(3), 337–347.

Berglind, R., D. Menning, R. Tryman, A. Helte, P. Leffler, and R. M. Karlsson. (2009). *Environmental Effects of Underwater Explosions: A Literature Study*. Kjeller, Norway: Forsvarets Forskningsinstitut.

Bergström, L., L. Kautsky, T. Malm, R. Rosenberg, M. Wahlberg, N. Åstrand Capetillo, and D. Wilhelmsson. (2014). Effects of offshore wind farms on marine wildlife–A generalized impact assessment. *Environmental Research Letters, 9*(3), 12.

Berkson, H. (1967). Physiological adjustments to deep diving in the Pacific green turtle (*Chelonia mydas agassizii*). *Comparative Biochemistry and Physiology, 21*(3), 507–524.

Berry, K. A., M. E. Peixoto, and S. S. Sadove. (2000). *Occurrence, Distribution and Abundance of Green Turtles, Chelonia mydas, in Long Island New York: 1986–1987* (Proceedings of the Eighteenth International Sea Turtle Symposium). Mazatlan, Sinaloa, Mexico: U.S. Department of Commerce, National Oceanic and Atmospheric Administration.

Bierman, H. S., J. L. Thornton, H. G. Jones, K. Koka, B. A. Young, C. Brandt, J. Christensen-Dalsgaard, C. E. Carr, and D. J. Tollin. (2014). Biophysics of directional hearing in the American alligator (*Alligator mississippiensis*). *The Journal of Experimental Biology, 217*(Pt 7), 1094–1107.

Bilkovic, D. M., K. Havens, D. Stanhope, and K. Angstadt. (2014). Derelict fishing gear in Chesapeake Bay, Virginia: Spatial patterns and implications for marine fauna. *Marine Pollution Bulletin, 80*(1-2), 114–123.

Bjorndal, K. A., and A. B. Bolten. (1988). Growth rates of immature green turtles, *Chelonia mydas*, on feeding grounds in the southern Bahamas. *Copeia, 1988*(3), 555–564.

Bjorndal, K. A., A. B. Bolten, and C. Lagueux. (1994). Ingestion of Marine Debris by Juvenile Sea Turtles in Coastal Florida Habitats. *Marine Pollution Bulletin, 28*(3), 154–158.

Bjorndal, K. A. (1997). Foraging ecology and nutrition of sea turtles. In P. L. Lutz & J. A. Musick (Eds.), *The Biology of Sea Turtles* (pp. 199–231). Boca Raton, FL: CRC Press.

Bjorndal, K. A., A. B. Bolten, and H. R. Martins. (2000). Somatic growth model of juvenile loggerhead sea turtles *Caretta caretta*: Duration of pelagic stage. *Marine Ecology Progress Series, 202*, 265–272.

Bjorndal, K. A., A. B. Bolten, B. Koike, B. A. Schroeder, D. J. Shaver, W. G. Teas, and W. N. Witzell. (2001). Somatic growth function for immature loggerhead sea turtles, *Caretta caretta*, in southeastern U.S. waters. *Fishery Bulletin, 99*, 240–246.

Bjorndal, K. A. (2003). Roles of loggerhead sea turtles in marine ecosystems. In A. B. Bolten & B. E. Witherington (Eds.), *Loggerhead Sea Turtles* (pp. 235–254). Washington, DC: Smithsonian Institution Press.

Bolten, A. B., H. R. Martins, K. A. Bjorndal, M. Cocco, and G. Gerosa. (1992). *Caretta caretta* (loggerhead). Pelagic movement and growth. *Herpetological Review, 23*(4), 116.

Bolten, A. B., K. A. Bjorndal, H. R. Martins, T. Dellinger, M. J. Biscoito, S. E. Encalada, and B. W. Bowen. (1998). Transatlantic developmental migrations of loggerhead sea turtles demonstrated by mtDNA sequence analysis. *Ecological Applications, 8*(1), 1–7.

Bolten, A. B. (2003a). Variation in sea turtle life history patterns: Neritic vs. oceanic developmental stages. In P. L. Lutz, J. A. Musick, & J. Wyneken (Eds.), *The Biology of Sea Turtles* (Vol. II, pp. 243–258). Boca Raton, FL: CRC Press.

Bolten, A. B. (2003b). Active swimmers-passive drifters: The oceanic juvenile stage of loggerheads in the Atlantic system. In A. B. Bolten & B. E. Witherington (Eds.), *Loggerhead Sea Turtles* (pp. 63–78). Washington, DC: Smithsonian Books.

Bovery, C. M., and J. Wyneken. (2015). Seasonal variation in sea turtle density and abundance in the southeast Florida current and surrounding waters. *PLoS ONE, 10*(12), e0145980.

Bowen, B. W., A. L. Bass, S.-M. Chow, M. Bostrom, K. A. Bjorndal, A. B. Bolten, T. Okuyama, B. M. Bolker, S. Epperly, E. Lacasella, D. Shaver, M. Dodd, S. R. Hopkins-Murphy, J. A. Musick, M. Swingle, K. Rankin-Baransky, W. Teas, W. N. Witzell, and P. H. Dutton. (2004). Natal homing in juvenile loggerhead turtles *(Caretta caretta)*. *Molecular Ecology, 13*, 3797–3808.

Boyer, J. N., J. W. Fourqurean, and R. D. Jones. (1999). Seasonal and long-term trends in the water quality of Florida Bay (1989–1997). *Estuaries, 22*(2), 417–430.

Brandt, L. A., J. S. Beauchamp, B. M. Jeffery, M. S. Cherkiss, and F. J. Mazzotti. (2016). Fluctuating water depths affect American alligator (*Alligator mississippiensis*) body condition in the Everglades, Florida, USA. *Ecological Indicators, 67*, 441–450.

Brautigam, A., and K. L. Eckert. (2006). *Turning the Tide: Exploitation, Trade and Management of Marine Turtles in the Lesser Antilles, Central America, Columbia, and Venezuela*. Cambridge, UK: Traffic International.

Bresette, M., J. Gorham, and B. Peery. (1998). Site fidelity and size frequencies of juvenile green turtles (*Chelonia mydas*) utilizing near shore reefs in St. Lucie County, Florida. *Marine Turtle Newsletter, 82*, 5–7.

Bresette, M., D. Singewald, and E. De Maye. (2006). Recruitment of post-pelagic green turtles (*Chelonia mydas*) to nearshore reefs on Florida's east coast. In M. Frick, A. Panagopoulou, A. F. Rees, & K. Williams (Eds.), *Twenty-sixth Annual Symposium on Sea Turtle Biology and Conservation: Book of Abstracts* (pp. 288). Athens, Greece: National Marine Fisheries Service Southeast Fisheries Science Center, International Sea Turtle Society.

Briggs-Gonzalez, V., C. Bonenfant, M. Basille, M. Cherkiss, J. Beauchamp, and F. Mazzotti. (2017). Life histories and conservation of long-lived reptiles, an illustration with the American Crocodile (*Crocodylus acutus*). *Journal of Animal Ecology, 86*, 1102–1113.

Briggs, C., S. M. Shjegstad, J. A. K. Silva, and M. H. Edwards. (2016). Distribution of chemical warfare agent, energetics, and metals in sediments at a deep-water discarded military munitions site. *Deep Sea Research Part II: Topical Studies in Oceanography, 128*, 63–69.

Briscoe, D. K., D. M. Parker, G. H. Balazs, M. Kurita, T. Saito, H. Okamoto, M. Rice, J. J. Polovina, and L. B. Croder. (2016). Active dispersal in loggerhead sea turtles (*Caretta caretta*) during the 'lost years'. *Proceeding of the Royal Society B, 283*, 20160690.

Britton, A. (2009). *Alligator mississippiensis (Daudin, 1801)*. Retrieved from http://crocodilian.com/cnhc/csp_amis.htm.

Brothers, J. R., and K. J. Lohmann. (2015). Evidence for geomagnetic imprinting and magnetic navigation in the natal homing of sea turtles. *Current Biology, 25*(3), 392–396.

Browlow, A., J. Onoufriou, A. Bishop, N. Davidson, and D. Thompson. (2016). Corkscrew Seals: Grey Seal (*Halichoerus grypus*) infanticide and cannibalisng may indicate the cause of spiral lacerations in seals. *PLoS ONE, 11*(6), e0156464.

Bugoni, L., T. S. Neves, N. O. Leite, Jr., D. Carvalho, G. Sales, R. W. Furness, C. E. Stein, F. V. Peppes, B. B. Giffoni, and D. S. Monteiro. (2008). Potential bycatch of seabirds and turtles in hook-and-line fisheries of the Itaipava Fleet, Brazil. *Fisheries Research, 90*, 217–224.

Bureau of Ocean Energy Management. (2011). *Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species*. Camarillo, CA: U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement, Pacific OCS Region.

Burkholder, J., D. Eggleston, H. Glasgow, C. Brownie, R. Reed, G. Janowitz, M. Posey, G. Mella, C. Kinder, R. Corbett, D. Toms, T. Alphin, N. Deamer, and J. Springer. (2004). Comparative impacts of two major hurricane seasons on the Neuse River and western Pamlico Sound ecosystems. *Proceedings of the National Academy of Sciences, 101*(25), 9291–9296.

Burns, T. J., H. Davidson, and M. W. Kennedy. (2016). Large-scale investment in the excavation and "camouflaging" phases by nesting Leatherback Turtles (*Dermochelys coriacea*). *Canadian Journal of Zoology, 94*(6), 443–448.

Burt, M. L., L. A. S. Scott-Hayward, and D. L. Borchers. (2014). *Analysis of Aerial Surveys Conducted in Coastal Waters of Maryland and Virginia, Including Chesapeake Bay, 2011–2013: Loggerhead Turtles. Draft Report.* Norfolk, VA: Naval Facilities Engineering Command Atlantic.

Caillouet, C. W., B. J. Gallaway, and N. F. Putman. (2016). Kemp's Ridley Sea Turtle saga and setback: Novel analyses of cumulative hatchlings released and time-lagged annual nests in Tamaulipas, Mexico. *Chelonian Conservation and Biology, 15*(1), 115–131.

Caillouet, C. W., Jr., R. A. Hart, and J. M. Nance. (2008). Growth overfishing in the brown shrimp fishery of Texas, Louisiana, and adjoining Gulf of Mexico EEZ. *Fisheries Research, 92*, 289–302.

Campbell, C. (2016). Port of Baltimore's first container ship through expanded Panama Canal carries hope for future. *The Baltimore Sun*. Retrieved from http://www.baltimoresun.com/business/bs-bz-panama-canal-expansion-20160715-story.html.

Carr, A., and A. B. Meylan. (1980). Evidence of passive migration of green turtle hatchlings in *Sargassum*. *Copeia, 1980*(2), 366–368.

Carr, A. (1986). Rips, FADS, and little loggerheads: Years of research have told us much about the behavioral ecology of sea turtles, but mysteries remain. *BioScience, 36*(2), 92–100.

Carr, A. (1987). New perspectives on the pelagic stage of sea turtle development. *Conservation Biology, 1*(2), 103–121.

Ceccarelli, D. M. (2009). *Impacts of Plastic Debris on Australian Marine Wildlife*. Canberra, Australia: Department of the Environment, Water, Heritage and the Arts.

Chaloupka, M., T. M. Work, G. H. Balazs, S. K. K. Murakawa, and R. Morris. (2008). Cause-specific temporal and spatial trends in green sea turtle strandings in the Hawaiian Archipelago (1982–2003). *Marine Biology, 154*, 887–898.

Chaloupka, M., G. H. Balazs, and T. M. Work. (2009). Rise and fall over 26 years of a marine epizootic in Hawaiian green sea turtles. *Journal of Wildlife Diseases, 45*(4), 1138–1142.

Chapman, R., and J. A. Seminoff. (2016). *Status of Loggerhead Turtles (Caretta caretta) within Nations of the Inter-American Convention for the Protection and Conservation of Sea Turtles*. Argentina, Belize, Brazil, Chile, Costa Rica, Ecuador, Guatemala, Honduras, Panama, Mexico, Peru, the Netherlands, United States of America, Uruguay and Venezuela: Inter-American Convention for the Protection and Conservation of Sea Turtles.

Cherkiss, M. S., F. J. Mazzotti, L. Hord, and M. Aldecoa. (2014). Remarkable movements of an American crocodile (*Crocodylus acutus*) in Florida. *Southeastern Naturalist, 13*(4), N52–N56.

Christian, E. A., and J. B. Gaspin. (1974). *Swimmer Safe Standards from Underwater Explosions. Navy Science Assistance Program Project No. PHP-11-73*. White Oak, MD: Naval Ordnance Laboratory.

Christiansen, F., N. F. Putman, R. Farman, D. M. Parker, M. R. Rice, J. J. Polovina, G. H. Balazs, and G. C. Hays. (2016). Spatial variation in directional swimming enables juvenile sea turtles to reach and remain in productive waters. *Marine Ecology Progress Series, 557*, 247–259.

Clark, S. L., and J. W. Ward. (1943). The effects of rapid compression waves on animals submerged in water. *Surgery, Gynecology & Obstetrics, 77*, 403–412.

Collazo, J. A., R. Boulon, and T. L. Tallevast. (1992). Abundance and growth patterns of *Chelonia mydas* in Culebra, Puerto Rico. *Journal of Herpetology, 26*(3), 293–300.

Conant, T. A., P. H. Dutton, T. Eguchi, S. P. Epperly, C. C. Fahy, M. H. Godfrey, S. L. MacPherson, E. E. Possardt, B. A. Schroeder, J. A. Seminoff, M. L. Snover, C. M. Upite, and B. E. Witherington. (2009). *Loggerhead sea turtle (Caretta caretta) 2009 status review under the U.S. Endangered Species Act* (Report of the loggerhead biological review team to the National Marine Fisheries Service, August 2009). Silver Spring, MD: Loggerhead Biological Review Team.

Cook, C. (2016). *Impacts Of Invasive Phragmites Australis On Diamondback Terrapin Nesting.* (Master's thesis). College of William and Mary, Williamsburg, VA.

Cook, S. L., and T. G. Forrest. (2005). Sounds produced by nesting leatherback sea turtles (*Dermochelys coriacea*). *Herpetological Review, 36*(4), 387–389.

Corn, M. L. (2010). *Deepwater Horizon Oil Spill: Coastal Wetland and Wildlife Impacts and Response*. Collingdale, PA: Diane Publishing Co.

Corning Incorporated. (2005). *Corning SMF-28e Optical Fiber Product Information*. Corning, NY: Corning Incorporated.

Coyne, M. S., M. E. Monaco, and A. M. Landry, Jr. (2000). *Kemp's ridley habitat suitability index model* (Proceedings of the Eighteenth International Sea Turtle Symposium). Mazatlán, Sinaloa, México: U.S. Department of Commerce, National Oceanic and Atmospheric Administration.

Craig, J. C., Jr. (2001). *Appendix D, Physical Impacts of Explosions on Marine Mammals and Turtles Final Environmental Impact Statement, Shock Trial of the Winston Churchill (DDG 81)*. Washington, DC: U.S. Department of the Navy, Naval Sea Systems Command.

Cummings, E., R. McAlarney, W. McLellan, and D. A. Pabst. (2016). *Aerial Surveys for Protected Species in the Jacksonville Opearating Area: 2015 Annual Progress Report*. Virginia Beach, VA: U.S. Fleet Forces Command.

Davenport, J. (1988). Do diving leatherbacks pursue glowing jelly? *British Herpetological Society Bulletin, 24*, 20–21.

Day, R. D., R. D. McCauley, Q. P. Fitzgibbon, and J. M. Semmens. (2016). Seismic air gun exposure during early-stage embryonic development does not negatively affect spiny lobster *Jasus edwardsii* larvae (Decapoda: Palinuridae). *Scientific Reports, 6*(22723), 9.

Denkinger, J., M. Parra, J. P. Muñoz, C. Carrasco, J. C. Murillo, E. Espinosa, F. Rubianes, and V. Koch. (2013). Are boat strikes a threat to sea turtles in the Galapagos Marine Reserve? *Ocean & Coastal Management, 80*, 29–35.

DeRuiter, S. L., and K. L. Doukara. (2012). Loggerhead turtles dive in response to airgun sound exposure. *Endangered Species Research, 16*(1), 55–63.

Dew, L. A., R. G. Owen, and M. J. Mulroy. (1993). Changes in size and shape of auditory hair cells in vivo during noise-induced temporary threshold shift. *Hearing Research, 66*(1), 99–107.

Dodd, C. K., Jr. (1988). *Synopsis of the Biological Data on the Loggerhead Sea Turtle, Caretta caretta (Linnaeus 1758)*. Washington, DC: U.S. Fish and Wildlife Service.

Dorcas, M. E., J. D. Willson, R. N. Reed, R. W. Snow, M. R. Rochford, M. A. Miller, W. E. Meshaka, P. T. Andreadis, F. J. Mazzotti, and C. M. Romagosa. (2012). Severe mammal declines coincide with proliferation of invasive Burmese pythons in Everglades National Park. *Proceedings of the National Academy of Sciences, 109*(7), 2418–2422.

Draud, M., M. Bossert, and S. Zimnavoda. (2004). Predation on hatchling and juvenile diamondback terrapins (*Malaclemys terrapin*) by the Norway rat (*Rattus norvegicus*). *Journal of Herpetology, 38*(3), 467–470.

Eckert, S. A., K. L. Eckert, P. Ponganis, and G. L. Kooyman. (1989). Diving and foraging behavior of leatherback sea turtles (*Dermochelys coriacea*). *Canadian Journal of Zoology, 67*, 2834–2840.

Eckert, S. A. (2002). Distribution of juvenile leatherback sea turtle, *Dermochelys coriacea,* sightings. *Marine Ecology Progress Series, 230*, 289–293.

Edmonds, N. J., C. J. Firmin, D. Goldsmith, R. C. Faulkner, and D. T. Wood. (2016). A review of crustacean sensitivity to high amplitude underwater noise: Data needs for effective risk assessment in relation to UK commercial species. *Marine Pollution Bulletin, 108*, 5–11.

Edwards, M. H., S. M. Shjegstad, R. Wilkens, J. C. King, G. Carton, D. Bala, B. Bingham, M. C. Bissonnette, C. Briggs, N. S. Bruso, R. Camilli, M. Cremer, R. B. Davis, E. H. DeCarlo, C. DuVal, D. J. Fornari, I. Kaneakua-Pia, C. D. Kelley, S. Koide, C. L. Mah, T. Kerby, G. J. Kurras, M. R. Rognstad, L. Sheild, J. Silva, B. Wellington, and M. V. Woerkom. (2016). The Hawaii undersea military munitions assessment. *Deep Sea Research Part II: Topical Studies in Oceanography, 128*, 4–13.

Eisenberg, J. F., and J. Frazier. (1983). A leatherback turtle (*Dermochelys coriacea*) feeding in the wild. *Journal of Herpetology, 17*(1), 81–82.

Elsey, R. M., N. Kinler, V. Lance, and W. Parke Moore, III. (2006). *Effects of Hurricanes Katrina and Rita on alligators (Alligator mississippiensis) in Louisiana.* Paper presented at the 18th Working Meeting of the International Union, for Conservation of Nature-Species Survival Commission, Crocodile Specialist Group. Montelimar, France.

Elsey, R. M., and A. R. Woodward. (2010). American Alligator, *Alligator mississippiensis*. In S. C. Manolis & C. Stevenson (Eds.), *Crocodiles. Status Survey and Conservation Action Plan* (3rd ed., pp. 1–4). Gland, Switzerland and Cambridge, UK: Crocodile Specialist Group, International Union for Conservation of Nature.

Engeman, R. M., D. Addison, and J. C. Griffin. (2016). Defending against disparate marine turtle nest predators: Nesting success benefits from eradicating invasive feral swine and caging nests from raccoons. *Oryx, 50*(02), 289–295.

Environmental Sciences Group. (2005). *Canadian Forces Maritime Experimental and Test Ranges: Environmental Assessment Update 2005*. Kingston, Canada: Environmental Sciences Group, Royal Military College.

Epperly, S. P., J. Braun, and A. J. Chester. (1995a). Aerial surveys for sea turtles in North Carolina inshore waters. *Fishery Bulletin, 93*, 254–261.

Epperly, S. P., J. Braun, A. J. Chester, F. A. Cross, J. V. Merriner, and P. A. Tester. (1995b). Winter distribution of sea turtles in the vicinity of Cape Hatteras and their interactions with the summer flounder trawl fishery. *Bulletin of Marine Science, 56*(2), 547–568.

Epperly, S. P., J. Braun, and A. Veishlow. (1995c). Sea turtles in North Carolina waters. *Conservation Biology, 9*(2), 384–394.

Eriksson, C., and H. Burton. (2003). Origins and biological accumulation of small plastic particles in fur seals from Macquarie Island. *Ambio, 32*(6), 380–384.

Eversole, C. B., S. E. Henke, D. B. Wester, B. M. Ballard, and R. L. Powell. (2015). Responses of American Alligators (*Alligator mississippiensis*) to Environmental Conditions: Implications for Population and Ecosystem Monitoring. *Herpetologica, 71*(1), 37–45.

Fergusson, I. K., L. J. V. Compagno, and M. A. Marks. (2000). Predation by white sharks *Carcharodon carcharias* (Chondrichthyes: Lamnidae) upon chelonians, with new records from the Mediterranean Sea and a first record of the ocean sunfish *Mola mola* (Osteichthyes: Molidae) as stomach contents. *Environmental Biology of Fishes, 58*, 447–453.

Ferrara, C. R., R. C. Vogt, M. R. Harfush, R. S. Sousa-Lima, E. Albavera, and A. Tavera. (2014). First evidence of leatherback turtle (*Dermochelys coriacea*) embryos and hatchlings emitting sounds. *Chelonian Conservation and Biology, 13*(1), 110–114.

Figgener, C., D. Chacón-Chaverri, M. P. Jensen, and H. Feldhaar. (2016). Paternity re-visited in a recovering population of Caribbean leatherback turtles (*Dermochelys coriacea*). *Journal of Experimental Marine Biology and Ecology, 475*, 114–123.

Finkbeiner, E. M., B. P. Wallace, J. E. Moore, R. L. Lewison, L. B. Crowder, and A. J. Read. (2011). Cumulative estimates of sea turtle bycatch and mortality in USA fisheries between 1990 and 2007. *Biological Conservation, 144*(11), 2719–2727.

Fish, M. R., I. M. Cote, J. A. Horrocks, B. Mulligan, A. R. Watkinson, and A. P. Jones. (2008). Construction setback regulations and sea-level rise: Mitigating sea turtle nesting beach loss. *Ocean & Coastal Management, 51*(4), 330–341.

Fishman, J., K. MacKinnon, and S. Baker. (2009). *Crocodylus acutus*. *University of Michigan Animal Diversity Web.* Retrieved from http://animaldiversity.ummz.umich.edu/site/accounts/information/Crocodylus_acutus.html.

Florida Fish and Wildlife Conservation Commission. (2017). *Index Nesting Beach Survey Totals (1989–2017)*. Retrieved from http://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/.

Florida Fish and Wildlife Conservation Commission. (n.d.). *American crocodile, Crocodylus acutus*. Retrieved from http://myfwc.com/crocodile/.

Flower, J. E., T. M. Norton, K. M. Andrews, S. E. Nelson, C. E. Parker, L. M. Romero, and M. A. Mitchell. (2015). Baseline plasma corticosterone, haematological and biochemical results in nesting and rehabilitating loggerhead sea turtles (*Caretta caretta*). *Conservation Physiology, 3*(1), cov003.

Foley, A. M., P. H. Dutton, K. E. Singel, A. E. Redlow, and W. G. Teas. (2003). The first records of olive ridleys in Florida, U.S.A. *Marine Turtle Newsletter, 101*, 23–25.

Fossette, S., S. Ferraroli, H. Tanaka, Y. Ropert-Coudert, N. Arai, K. Sato, Y. Naito, Y. Le Maho, and J. Georges. (2007). Dispersal and dive patterns in gravid leatherback turtles during the nesting season in French Guiana. *Marine Ecology Progress Series, 338*, 233–247.

Foster, T., and J. P. Gilmour. (2016). Seeing red: Coral larvae are attracted to healthy-looking reefs. *Marine Ecology Progress Series, 559*, 65–71.

Frick, M. G., C. A. Quinn, and C. K. Slay. (1999). *Dermochelys coriacea* (leatherback sea turtle), *Lepidochelys kempii* (Kemp's ridley sea turtle), and *Caretta caretta* (loggerhead sea turtle): pelagic feeding. *Herpetological Review, 30*(3), 165.

Frost, M. T., S. Dye, B. Stoker, P. Buckley, and J. Baxter. (2017). *Marine Climate Change Impacts: 10 Years' Experience of Science to Policy Reporting. Summary Report*. London, United Kingdom: Marine Climate Change Impacts Partnership.

Fuentes, M. M. P. B., D. A. Pike, A. Dimatteo, and B. P. Wallace. (2013). Resilience of marine turtle regional management units to climate change. *Global Change Biology, 19*(5), 1399–1406.

Fukuoka, T., M. Yamane, C. Kinoshita, T. Narazaki, G. J. Marshall, K. J. Abernathy, N. Miyazaki, and K. Sato. (2016). The feeding habit of sea turtles influences their reaction to artificial marine debris. *Scientific Reports, 6*, 28015.

Furin, C. G., F. A. von Hippel, B. Hagedorn, and T. M. O'Hara. (2013). Perchlorate trophic transfer increases tissue concentrations above ambient water exposure alone in a predatory fish. *Journal of Toxicology and Environmental Health. Part A, 76*(18), 1072–1084.

Garcia-Parraga, D., J. L. Crespo-Picazo, Y. B. de Quiros, V. Cervera, L. Marti-Bonmati, J. Diaz-Delgado, M. Arbelo, M. J. Moore, P. D. Jepson, and A. Fernandez. (2014). Decompression sickness ('the bends') in sea turtles. *Diseases of Aquatic Organisms, 111*(3), 191–205.

Gardner, B., L. A. Garner, D. T. Cobb, and C. E. Moorman. (2016). Factors affecting occupancy and abundance of American alligators at the northern extent of their range. *Journal of Herpetology, 50*(4), 541–547.

Garrick, L. D., J. W. Lang, and H. A. Herzog. (1978). Social signals of adult American alligators. *Bulletin of the American Museum of Natural History, 160*(3), 163–192.

Gitschlag, G. R. (1996). Migration and diving behavior of Kemp's ridley (Garman) sea turtles along the U.S. southeastern Atlantic coast. *Journal of Experimental Marine Biology and Ecology, 205*, 115–135.

Glandon, H. L., and T. J. Miller. (2016). No effect of high pCO_2 on juvenile blue crab, *Callinectes sapidus*, growth and consumption despite positive responses to concurrent warming. *ICES Journal of Marine Science, 74*(4), 1201–1209.

Gleich, O., and G. A. Manley. (2000). The hearing organ of birds and crocodilia. In R. Dooling, A. N. Popper, & R. R. Fay Springer-Verlag (Eds.), *Comparative Hearing: Birds and Reptiles* (pp. 70–138). New York, NY: Springer Handbook of Auditory Research.

Godley, B. J., D. R. Thompson, S. Waldron, and R. W. Furness. (1998). The trophic status of marine turtles as determined by stable isotope analysis. *Marine Ecology Progress Series, 166*, 277–284.

Goertner, J. F. (1978). *Dynamical Model for Explosion Injury to Fish*. Dalgren, VA: U.S. Department of the Navy, Naval Surface Weapons Center.

Gonzalez, L. A. (2011). State of the Bay: Water and Sediment Quality. In *A Characterization of the Galveston Bay Ecosystem* (Third ed., pp. 1–45). Austin, TX: Texas Commission on Environmental Quality, Galveston Bay Estuary Program.

Grant, G. S., and D. Ferrell. (1993). Leatherback turtle, *Dermochelys coriacea* (Reptilia: *Dermochelidae*): Notes on near-shore feeding behavior and association with cobia. *Brimleyana, 19*, 77–81.

Grant, P. B. C., and T. R. Lewis. (2010). High speed boat traffic: A risk to crocodilian populations. *Herpetological Conservation and Biology, 5*(3), 456–460.

Greaves, F. C., R. H. Draeger, O. A. Brines, J. S. Shaver, and E. L. Corey. (1943). An experimental study of concussion. *United States Naval Medical Bulletin, 41*(1), 339–352.

Green, T. W., D. H. Slone, E. D. Swain, M. S. Cherkiss, M. Lohmann, F. J. Mazzotti, and K. G. Rice. (2014). Evaluating effects of Everglades restoration on American crocodile populations in South Florida using a spatially-explicit, stage-based population model. *Wetlands, 34*(1), 213–224.

Gregory, L. F., and J. R. Schmid. (2001). Stress response and sexing of wild Kemp's ridley sea turtles (*Lepidochelys kempii*) in the Northeastern Gulf of Mexico. *General and Comparative Endocrinology, 124*, 66–74.

Griffin, D. B., S. R. Murphy, M. G. Frick, A. C. Broderick, J. W. Coker, M. S. Coyne, M. G. Dodd, M. H. Godfrey, B. J. Godley, and L. A. Hawkes. (2013). Foraging habitats and migration corridors utilized by a recovering subpopulation of adult female loggerhead sea turtles: Implications for conservation. *Marine Biology, 160*(12), 3071–3086.

Grigg, G., and C. Gans. (1993). Morphology and physiology of the Crocodylia *Fauna of Australia Vol 2A Amphibia and Reptilia* (pp. 326–336). Canberra, Australia: Australian Government Publishing Service.

Hackney, A. D. (2010). *Conservation biology of the diamondback terrapin in North America: Policy status, nest predation, and managing island populations*. Clemson, SC: Clemson University.

Hardesty, B. D., and C. Wilcox. (2017). A risk framework for tackling marine debris. *Royal Society of Chemistry, 9*, 1429–1436.

Hart, K. M., and D. S. Lee. (2006). The Diamondback Terrapin: The Biology, Ecology, Cultural History, and Conservation Status of an Obligate Estuarine Turtle. In R. Greenberg, J. E. Maldonado, S. Droege, & M. V. McDonald (Eds.), *Terrestrial Vertebrates of Tidal Marshes: Evolution, Ecology, and Conservation*. Camarillo, CA: Cooper Ornithological Society.

Hart, K. M., P. J. Schofield, and D. R. Gregoire. (2012). Experimentally derived salinity tolerance of hatchling Burmese pythons (*Python molurus bivittatus*) from the Everglades, Florida (USA). *Journal of Experimental Marine Biology and Ecology, 413*, 56–59.

Hart, K. M., C. F. White, A. R. Iverson, and N. Whitney. (2016). Trading shallow safety for deep sleep: Juvenile green turtles select deeper resting sites as they grow. *Endangered Species Research, 31*, 61–73.

Hatase, H., K. Sato, M. Yamaguchi, K. Takahashi, and K. Tsukamoto. (2006). Individual variation in feeding habitat use by adult female green sea turtles (*Chelonia mydas*): Are they obligately neritic herbivores? *Oecologia, 149*, 52–64.

Hawaii Undersea Military Munitions Assessment. (2010). *Final Investigation Report HI-05 South of Pearl Harbor, O'ahu, Hawaii*. Honolulu, HI: University of Hawaii at Monoa and Environet Inc.

Hawkes, L. A., A. C. Broderick, M. S. Coyne, M. H. Godfrey, L.-F. Lopez-Jurado, P. Lopez-Suarez, S. E. Merino, N. Varo-Cruz, and B. J. Godley. (2006). Phenotypically linked dichotomy in sea turtle foraging requires multiple conservation approaches. *Current Biology, 16*, 990–995.

Hays, G. C., J. D. R. Houghton, C. Isaacs, R. S. King, C. Lloyd, and P. Lovell. (2004). First records of oceanic dive profiles for leatherback turtles, *Dermochelys coriacea*, indicate behavioural plasticity associated with long-distance migration. *Animal Behaviour, 67*, 733–743.

Hazel, J., I. R. Lawler, H. Marsh, and S. Robson. (2007). Vessel speed increases collision risk for the green turtle *Chelonia mydas*. *Endangered Species Research, 3*, 105–113.

Hazel, J., I. R. Lawler, and M. Hamann. (2009). Diving at the shallow end: Green turtle behaviour in near-shore foraging habitat. *Journal of Experimental Marine Biology and Ecology, 371*(1), 84–92.

Henry, A. G., T. V. N. Cole, L. Hall, W. Ledwell, D. Morin, and A. Reid. (2016). *Serious Injury and Mortality Determinations for Baleen Whale Stocks along the Gulf of Mexico, United States East Coast and Atlantic Canadian Provinces, 2010–2014*. Woods Hole, MA: U.S. Department of Commerce.

Henry, W. R., and M. J. Mulroy. (1995). Afferent synaptic changes in auditory hair cells during noise-induced temporary threshold shift. *Hearing Research, 84*(1), 81–90.

Hetherington, T. (2008). Comparative anatomy and function of hearing in aquatic amphibians, reptiles, and birds. In J. G. M. Thewissen & S. Nummela (Eds.), *Sensory Evolution on the Threshold* (pp. 182–209). Berkeley, CA: University of California Press.

Hidalgo-Ruz, V., L. Gutow, R. C. Thompson, and M. Thiel. (2012). Microplastics in the marine environment: A review of methods used for identification and quantification. *Environmental Science and Technology, 46*, 3060–3075.

Higgs, D. M., E. F. Brittan-Powell, D. Soares, M. J. Souza, C. E. Carr, R. J. Dooling, and A. N. Popper. (2002). Amphibious auditory responses of the American alligator (*Alligator mississipiensis*). *Journal of Comparative Physiology A, 188*, 217–223.

Hill, M. (1998). Spongivory on Caribbean reefs releases corals from competition with sponges. *Oecologia, 117*(1–2), 143–150.

Hillis, Z. (1990). *Buck Island Reef National Sea Turtle Research Program.* Paper presented at the Tenth Annual Workshop on Sea Turtle Biology and Conservation. Hilton Head, SC.

Hirth, H. F. (1997). *Synopsis of the Biological Data on the Green Turtle Chelonia mydas (Linnaeus 1758)*. Washington, DC: U.S. Fish and Wildlife Service.

Hochscheid, S., C. R. McMahon, C. J. A. Bradshaw, F. Maffucci, F. Bentivegna, and G. C. Hays. (2007). Allometric scaling of lung volume and its consequences for marine turtle diving performance. *Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology, 148*(2), 360–367.

Hochscheid, S. (2014). Why we mind sea turtles' underwater business: A review on the study of diving behavior. *Journal of Experimental Marine Biology and Ecology, 450*, 118–136.

Hodge, L. E. W. (2011). *Monitoring Marine Mammals in Onslow Bay, North Carolina, Using Passive Acoustics.* (Doctoral Dissertation in Philosophy). Duke University, Durham, NC. Retrieved from https://dukespace.lib.duke.edu.

Holloway-Adkins, K. G. (2006). Juvenile green turtles (*Chelonia mydas*) forage on high-energy, shallow reef on the east coast of Florida. In M. Frick, A. Panagopoulou, A. F. Rees, & K. Williams (Eds.), *Twenty-sixth Annual Symposium on Sea Turtle Biology and Conservation: Book of Abstracts*. Athens, Greece: National Marine Fisheries Service Southeast Fisheries Science Center, International Sea Turtle Society.

Hoopes, L. A., A. M. Landry Jr., and E. K. Stabenau. (2000). Physiological effects of capturing Kemp's ridley sea turtles, *Lepidochelys kempii*, in entanglement nets. *Canadian Journal of Zoology, 78*(11), 1941–1947.

Hopkins-Murphy, S. R., D. W. Owens, and T. M. Murphy. (2003). Ecology of immature loggerheads on foraging grounds and adults in internesting habitat in the eastern United States. In A. B. Bolten & B. E. Witherington (Eds.), *Loggerhead Sea Turtles* (pp. 79–92). Washington, DC: Smithsonian Institution Press.

Horrocks, J. A. (1987). Leatherbacks in Barbados. *Marine Turtle Newsletter, 41*, 7.

Horrocks, J. A., S. Stapleton, H. Guada, C. Lloyd, E. Harris, M. Fastigi, J. Berkel, K. Stewart, J. Gumbs, and K. L. Eckert. (2016). International movements of adult female leatherback turtles in the Caribbean: results from tag recovery data (2002–2013). *Endangered Species Research, 29*(3), 279–287.

Houghton, J. D. R., M. J. Callow, and G. C. Hays. (2003). Habitat utilization by juvenile hawksbill turtles (*Eretmochelys imbricata*, Linnaeus, 1766) around a shallow water coral reef. *Journal of Natural History, 37*, 1269–1280.

Hubbs, C., and A. Rechnitzer. (1952). Report on experiments designed to determine effects of underwater explosions on fish life. *California Fish and Game, 38*, 333–366.

Humber, F., B. J. Godley, and A. C. Broderick. (2014). So excellent a fishe: A global overview of legal marine turtle fisheries. *Diversity and Distributions, 20*(5), 579–590.

Illingworth and Rodkin, Inc. (2015). *Underwater and Airborne Acoustic Monitoring for the U.S. Navy Elevated Causeway Removal at the JEB Little Creek Naval Station: 10–11 September 2015* (Naval Facilities Engineering Command Atlantic under HDR Environmental, Operations and Construction, Inc.). Petaluma, CA: Illingworth & Rodkin, Inc.

Illingworth and Rodkin, Inc. (2017). *Pile-Driving Noise Measurements at Atlantic Fleet Naval Installations: 28 May 2013–28 April 2016. Final Report*. Petaluma, CA: HDR.

James, M. C., and T. B. Herman. (2001). Feeding of *Dermochelys coriacea* on medusae in the northwest Atlantic. *Chelonian Conservation and Biology, 4*(1), 202–205.

James, M. C., S. A. Eckert, and R. A. Myers. (2005a). Migratory and reproductive movements of male leatherback turtles (*Dermochelys coriacea)*. *Marine Biology, 147*, 845–853.

James, M. C., R. A. Myers, and C. A. Ottensmeyer. (2005b). Behaviour of leatherback sea turtles, *Dermochelys coriacea*, during the migratory cycle. *Proceedings of the Royal Society B: Biological Sciences, 272*, 1547–1555.

James, M. C., C. A. Ottensmeyer, and R. A. Myers. (2005c). Identification of high-use habitat and threats to leatherback sea turtles in northern waters: New directions for conservations. *Ecology Letters, 8*, 195–201.

James, M. C., S. A. Sherrill-Mix, K. Martin, and R. A. Myers. (2006). Canadian waters provide critical foraging habitat for leatherback sea turtles. *Biological Conservation, 133*(3), 347–357.

Jessop, T. S., A. D. Tucker, C. J. Limpus, and J. M. Whittier. (2003). Interactions between ecology, demography, capture stress, and profiles of corticosterone and glucose in a free-living population of Australian freshwater crocodiles. *General and Comparative Endocrinology, 132*(1), 161–170.

Johnson, M. L. (1989). Juvenile leatherback cared for in captivity. *Marine Turtle Newsletter, 47*, 13–14.

Karlsson, S., and A. C. Albertsson. (1998). Biodegradable polymers and environmental interaction. *Polymer Engineering and Science, 38*(8), 1251–1253.

Keinath, J. A., J. A. Musick, and R. A. Byles. (1987). Aspects of the biology of Virginia's sea turtles: 1979–1986. *Virginia Journal of Science, 38*(2), 81.

Kelley, C., G. Carton, M. Tomlinson, and A. Gleason. (2016). Analysis of towed camera images to determine the effects of disposed mustard-filled bombs on the deep water benthic community off south Oahu. *Deep Sea Research Part II: Topical Studies in Oceanography, 128*, 34–42.

Ketten, D. R., and S. Moein-Bartol. (2006). *Functional Measures of Sea Turtle Hearing*. Woods Hole, MA: Woods Hole Oceanographic Institution.

Klima, E. F., G. R. Gitschlag, and M. L. Renaud. (1988). Impacts of the explosive removal of offshore petroleum platforms on sea turtles and dolphins. *Marine Fisheries Review, 50*(3), 33–42.

Koide, S., J. A. K. Silva, V. Dupra, and M. Edwards. (2016). Bioaccumulation of chemical warfare agents, energetic materials, and metals in deep-sea shrimp from discarded military munitions sites off Pearl Harbor. *Deep Sea Research Part II: Topical Studies in Oceanography, 128*, 53–62.

Laloë, J.-O., N. Esteban, J. Berkel, and G. C. Hays. (2016). Sand temperatures for nesting sea turtles in the Caribbean: Implications for hatchling sex ratios in the face of climate change. *Journal of Experimental Marine Biology and Ecology, 474*, 92–99.

Lam, T., Lingxu, S. Takahashi, and E. A. Burgess. (2011). *Market Forces: An Examination of Marine Turtle Trade in China and Japan*. Hong Kong, China: TRAFFIC East Asia.

Lamont, M. M., I. Fujisaki, B. S. Stephens, and C. Hackett. (2015). Home range and habitat use of juvenile green turtles (*Chelonia mydas*) in the northern Gulf of Mexico. *Animal Biotelemetry, 3*(1), 53.

Lance, V. A., R. M. Elsey, G. Butterstein, and P. L. Trosclair III. (2004). Rapid suppression of testosterone secretion after capture in male American alligators (*Alligator mississippiensis*). *General and Comparative Endocrinology, 135*(2), 217–222.

Langhamer, O., H. Holand, and G. Rosenqvist. (2016). Effects of an Offshore Wind Farm on the Common Shore Crab *Carcinus maenas*: Tagging Pilot Experiments in the Lillgrund Offshore Wind Farm (Sweden). *PLoS ONE, 11*(10), 17.

Lavender, A. L., S. M. Bartol, and I. K. Bartol. (2014). Ontogenetic investigation of underwater hearing capabilities in loggerhead sea turtles (*Caretta caretta*) using a dual testing approach. *The Journal of Experimental Biology, 217*(Pt 14), 2580–2589.

Law, K. L., S. E. Moret-Ferguson, D. S. Goodwin, E. R. Zettler, E. Deforce, T. Kukulka, and G. Proskurowski. (2014). Distribution of surface plastic debris in the eastern Pacific Ocean from an 11-year data set. *Environmental Science & Technology, 48*(9), 4732–4738.

Lazell, J. D., Jr. (1980). New England waters: Critical habitat for marine turtles. *Copeia, 1980*(2), 290–295.

Lenhardt, M. L., S. Bellmund, R. A. Byles, S. W. Harkins, and J. A. Musick. (1983). Marine turtle reception of bone-conducted sound. *The Journal of Auditory Research, 23*, 119–125.

Lenhardt, M. L., R. C. Klinger, and J. A. Musick. (1985). Marine turtle middle-ear anatomy. *The Journal of Auditory Research, 25*, 66–72.

Lenhardt, M. L. (1994). *Seismic and very low frequency sound induced behaviors in captive loggerhead marine turtles (Caretta caretta).* Paper presented at the Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. Hilton Head, SC.

Leon, Y. M., and K. A. Bjorndal. (2002). Selective feeding in the hawksbill turtle, an important predator in coral reef ecosystems. *Marine Ecology Progress Series, 245*, 249–258.

Lester, L. A., E. A. Standora, W. F. Bien, and H. W. Avery. (2012). Behavioral Responses of Diamondback Terrapins (*Malaclemys terrapin terrapin*) to Recreational Boat Sounds. In A. N. Popper & A. Hawkins (Eds.), *The Effects of Noise on Aquatic Life*. New York, NY: Springer Science + Business Media.

Lester, L. A. (2013). *Direct and Indirect Effects of Recreational Boats on Diamondback Terrapins (Malaclemys terrapin).* (Unpublished doctoral dissertation). Drexel University, Philadelphia, PA. Retrieved from http://hdl.handle.net/1860/3982.

Lewis, J. D., J. W. Cain, III, and R. Denkhaus. (2014). Home range and habitat selection of an inland alligator (*Alligator mississippiensis*) population at the northwestern edge of the distribution range. *Southeastern Naturalist, 13*(2), 261–279.

Lewison, R. L., L. B. Crowder, B. P. Wallace, J. E. Moore, T. Cox, R. Zydelis, S. McDonald, A. DiMatteo, D. C. Dunn, C. Y. Kot, R. Bjorkland, S. Kelez, C. Soykan, K. R. Stewart, M. Sims, A. Boustany, A. J. Read, P. Halpin, W. J. Nichols, and C. Safina. (2014). Global patterns of marine mammal, seabird, and sea turtle bycatch reveal taxa-specific and cumulative megafauna hotspots. *PNAS, 111*(14), 5271–5276.

Liboff, A. R. (2015). Is the geomagnetic map imprinted in pre-emergent egg? *Electromagnetic Biology and Medicine, 35*(2), 167–169.

Lohmann, K. J., and C. M. F. Lohmann. (1996). Orientation and open-sea navigation in sea turtles. *The Journal of Experimental Biology, 199*, 73–81.

Lohmann, K. J., B. E. Witherington, C. M. F. Lohmann, and M. Salmon. (1997). Orientation, navigation, and natal beach homing in sea turtles. In P. L. Lutz & J. A. Musick (Eds.), *The Biology of Sea Turtles* (pp. 107–136). Boca Raton, FL: CRC Press.

Lutcavage, M., and J. A. Musick. (1985). Aspects of the biology of sea turtles in Virginia. *Copeia, 1985*(2), 449–456.

Lutcavage, M. E., P. G. Bushnell, and D. R. Jones. (1992). Oxygen stores and aerobic metabolism in the leatherback sea turtle. *Canadian Journal of Zoology, 70*(2), 348–351.

Lutcavage, M. E., and P. L. Lutz. (1997). Diving Physiology. In P. L. Lutz & J. A. Musick (Eds.), *The Biology of Sea Turtles* (pp. 277–296). Boca Raton, FL: CRC Press.

Lutcavage, M. E., P. Plotkin, B. Witherington, and P. L. Lutz. (1997). Human impacts on sea turtle survival. In P. L. Lutz & J. A. Musick (Eds.), *The Biology of Sea Turtles* (pp. 387–409). New York, NY: CRC Press.

Maison, K. A., I. K. Kelly, and K. P. Frutchey. (2010). *Green Turtle Nesting Sites and Sea Turtle Legislation throughout Oceania* (National Oceanic and Atmospheric Administration Technical Memorandum NMFS-F/SPO-110). Silver Spring, MD: Scientific Publications Office.

Mansfield, K. L. (2006). *Sources of mortality, movements and behavior of sea turtles in Virginia.* (PhD dissertation). College of William and Mary, Williamsburg, VA.

Marquez, M. R. (1994). *Synopsis of biological data on the Kemp's ridley turtle, Lepidochelys kempii (Garman, 1880)*. Silver Springs, MD: U.S. Department of Commerce, National Oceanic and Atmospheric Administration.

Márquez, M. R. (1990). *FAO Species Catalogue: Sea Turtles of the World; An Annotated and Illustrated Catalogue of Sea Turtle Species Known to Date*. Rome, Italy: United Nations Environment Programme, Food and Agriculture Organization of the United Nations.

Martin, K. J., S. C. Alessi, J. C. Gaspard, A. D. Tucker, G. B. Bauer, and D. A. Mann. (2012). Underwater hearing in the loggerhead turtle (*Caretta caretta*): A comparison of behavioral and auditory evoked potential audiograms. *The Journal of Experimental Biology, 215*(17), 3001–3009.

Mather, J. (2004). Cephalopod Skin Displays: From Concealment to Communication. In D. Kimbrough Oller and Ulrike Griebel (Ed.), *The Evolution of Communication Systems: A Comparative Approach*. Cambridge, MA: The Vienna Series in Theoretical Biology and the Massachusetts Institute of Technology.

Mathis, A., and F. R. Moore. (1988). Geomagnetism and the homeward orientation of the box turtle, *Terrapene carolina*. *Ethology, 78*(4), 265–274.

Mazzotti, F. J. (1983). *The Ecology of Crocodylus acutus in Florida: A Thesis in Ecology.* (Unpublished doctoral dissertation). Pennsylvania State University, University Park, PA.

Mazzotti, F. J., and W. A. Dunson. (1989). Osmoregulation in crocodilians. *American Zoologist, 29*, 903–920.

Mazzotti, F. J., L. A. Brandt, P. Moler, and M. S. Cherkiss. (2007). American crocodile (*Crocodylus acutus*) in Florida: Recommendations for endangered species recovery and ecosystem restoration. *Journal of Herpetology, 41*(1), 122–132.

Mazzotti, F. J. (2014). *American Crocodile Surveys on the Naval Air Station Key West*. Fort Lauderdale, FL: Department of Wildlife Ecology and Conservation Fort Lauderdale Research and Education Center University of Florida.

Mazzotti, F. J., M. S. Cherkiss, M. Parry, J. Beauchamp, M. Rochford, B. Smith, K. Hart, and L. A. Brandt. (2016). Large reptiles and cold temperatures: Do extreme cold spells set distributional limits for tropical reptiles in Florida? *Ecosphere, 7*(8), 1–9 e01439.

McCauley, R. D., J. Fewtrell, A. J. Duncan, C. Jenner, M.-N. Jenner, J. D. Penrose, R. I. T. Prince, A. Adhitya, J. Murdoch, and K. McCabe. (2000). Marine seismic surveys: A study of environmental implications. *Australian Petroleum Production Exploration Association Journal, 2000*, 692–708.

McCauley, S., and K. Bjorndal. (1999). Conservation implications of dietary dilution from debris ingestion: Sublethal effects in post-hatchling loggerhead sea turtles. *Conservation Biology, 13*(4), 925–929.

Meylan, A. (1988). Spongivory in hawksbill turtles: A diet of glass. *Science, 239*(4838), 393–395.

Meylan, A. (1995). Sea turtle migration—Evidence from tag returns. In K. A. Bjorndal (Ed.), *Biology and Conservation of Sea Turtles* (Revised ed., pp. 91–100). Washington, DC: Smithsonian Institution Press.

Meylan, A. B., B. E. Witherington, B. Brost, R. Rivero, and P. S. Kubilis. (2006). Sea turtle nesting in Florida, USA: Assessments of abundance and trends for regionally significant populations of *Caretta, Chelonia*, and *Dermochelys*. In M. Frick, A. Panagopoulou, A. F. Rees, & K. Williams (Eds.), *Twenty-sixth Annual Symposium on Sea Turtle Biology and Conservation: Book of Abstracts* (pp. 306–307). Athens, Greece: National Marine Fisheries Service Southeast Fisheries Science Center, International Sea Turtle Society.

Michel, J. M., R. Greer, M. Hoffman, P. McGowan, and R. Wood. (2001). *Acute Mortality of Diamondback Terrapins from the Chalk Point Oil Spill*. Silver Spring, MD: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Damage Assessment, Remediation, and Restoration Program.

Mintz, J. D., and R. J. Filadelfo. (2011). *Exposure of Marine Mammals to Broadband Radiated Noise* (Specific Authority N0001-4-05-D-0500). Washington, DC: Center for Naval Analyses.

Mintz, J. D. (2012). *Vessel Traffic in the Hawaii-Southern California and Atlantic Fleet Testing and Training Study Areas*. (CRM D0026186.A2/Final). Alexandria, VA: Center for Naval Analyses.

Mitchelmore, C. L., C. A. Bishop, and T. K. Collier. (2017). Toxicological estimation of mortality of oceanic sea turtles oiled during the Deepwater Horizon oil spill. *Endangered Species Research, 33*, 39–50.

Moein Bartol, S. E., J. A. Musick, J. A. Keinath, D. E. Barnard, M. L. Lenhardt, and R. George. (1995). Evaluation of Seismic Sources for Repelling Sea Turtles from Hopper Dredges. In L. Z. Hales (Ed.), *Sea Turtle Research Program: Summary Report* (Vol. Technical Report CERC-95, pp. 90–93). Kings Bay, GA: U.S. Army Engineer Division, South Atlantic, Atlanta, GA and U.S. Naval Submarine Base.

Morreale, S. J., and E. A. Standora. (1998). *Early life stage ecology of sea turtles in northeastern U.S. waters*. Silver Springs, MD: U.S. Department of Commerce, National Oceanic and Atmospheric Administration.

Mortimer, J. A. (1995). Feeding ecology of sea turtles. In K. A. Bjorndal (Ed.), *Biology and Conservation of Sea Turtles* (Revised ed., pp. 103–109). Washington, DC: Smithsonian Institution Press.

Mortimer, J. A., and M. Donnelly. (2008). *Hawksbill Turtle (Eretmochelys imbricate): Marine Turtle Specialist Group 2008 International Union for Conservation of Nature Red List Status Assessment*. Retrieved from http://www.iucnredlist.org/details/8005/0.

Mrosovsky, N. (1972). Spectrographs of the sounds of leatherback turtles. *Herpetologica, 28*(3), 256–258.

Mrosovsky, N., G. D. Ryan, and M. C. James. (2009). Leatherback turtles: The menace of plastic. *Marine Pollution Bulletin, 58*(2), 287–289.

Murray, C. C., A. Bychkov, T. Therriault, H. Maki, and N. Wallace. (2015). The impact of Japanese tsunami debris on North America. *PICES Press, 23*(1), 28.

Murray, M. (2011, August 21). Previously believed loggerhead was actually a green turtle. *The News Journal*. Retrieved from http://www.delawareonline.com/.

Musick, J. A., and C. J. Limpus. (1997). Habitat utilization and migration of juvenile sea turtles. In P. L. Lutz & J. A. Musick (Eds.), *The Biology of Sea Turtles* (pp. 137–163). Boca Raton, FL: CRC Press.

Nagaoka, S., A. Martins, R. dos Santos, M. Tognella, E. de Oliveira Filho, and J. Seminoff. (2012). Diet of juvenile green turtles (*Chelonia mydas*) associating with artisanal fishing traps in a subtropical estuary in Brazil. *Marine Biology, 159*(3), 573–581.

Nance, J. M., C. W. Caillouet, Jr., and R. A. Hart. (2012). Size-composition of annual landings in the white shrimp, *Litopenaeus setiferus*, fishery of the northern Gulf of Mexico, 1960–2006: Its trends and relationships with other fishery-dependent variables. *Marine Fisheries Review, 72*(2), 1–13.

Narazaki, T., K. Sato, K. J. Abernathy, G. J. Marshall, and N. Miyazaki. (2013). Loggerhead turtles (*Caretta caretta*) use vision to forage on gelatinous prey in mid-water. *PLoS ONE, 8*(6), e66043.

National Marine Fisheries Service, and U.S. Fish and Wildlife Service. (1991). *Recovery Plan for U.S. Populations of Atlantic Green Turtle (Chelonia mydas)*. Washington, DC: National Marine Fisheries Service.

National Marine Fisheries Service, and U.S. Fish and Wildlife Service. (1993). *Recovery Plan for the Hawksbill Turtle (Eretmochelys imbricata) in the U.S. Caribbean, Atlantic and Gulf of Mexico* St. Petersburg, FL: National Marine Fisheries Service.

National Marine Fisheries Service, and U. S. Fish and Wildlife Service. (2007). *Hawksbill Sea Turtle (Eretmochelys imbricata) 5-year Review: Summary and Evaluation*. Silver Spring, MD: National Marine Fisheries Service.

National Marine Fisheries Service, and U.S. Fish and Wildlife Service. (2007). *Loggerhead Sea Turtle (Caretta caretta) 5-year review: Summary and Evaluation*. Silver Spring, MD: National Marine Fisheries Service.

National Marine Fisheries Service, and U.S. Fish and Wildlife Service. (2008). *Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle (Caretta caretta), Second Revision*. Silver Spring, MD: National Marine Fisheries Service.

National Marine Fisheries Service. (2010). Endangered and Threatened Species; Proposed Listing of Nine Distinct Population Segments of Loggerhead Sea Turtles as Endangered or Threatened. *Federal Register, 75*(50), 12598–12656.

National Marine Fisheries Service. (2011). *Sea Turtles and the Gulf of Mexico Oil Spill*. Retrieved from http://www.nmfs.noaa.gov/pr/health/oilspill/turtles.htm.

National Marine Fisheries Service, and U.S. Fish and Wildlife Service. (2011). *Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle (Lepidochelys kempii)*. Silver Spring, MD: U.S. Department of Commerce, National Oceanic and Atmospheric Administration.

National Marine Fisheries Service. (2013a). *2013 Annual Report of a Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US Waters of the Western North Atlantic Ocean*. Woods Hole, MA and Miami, FL: Northeast Fisheries Science Center and Southeast Fisheries Science Center.

National Marine Fisheries Service. (2013b). *Biological Opinion and Conference Opinion on Atlantic Fleet Training and Testing Activities (2013–2018)*. Silver Spring, MD: Office of Protected Resources.

National Marine Fisheries Service, and U.S. Fish and Wildlife Service. (2013a). *Hawksbill Sea Turtle (Eretmochelys imbricata) 5-Year Review: Summary and Evaluation*. Silver Spring, MD: Office of Protected Resources.

National Marine Fisheries Service, and U.S. Fish and Wildlife Service. (2013b). *Leatherback Turtle (Dermochelys coriacea) 5-Year Review: Summary and Evaluation*. Silver Spring, MD: National

Marine Fisheries Service Office of Protected Resources and U.S. Fish and Wildlife Service Southeast Region.

National Marine Fisheries Service. (2014a). *Deepwater Horizon Oil Spill 2010: Sea Turtles, Dolphins, and Whales*. Retrieved from https://www.fisheries.noaa.gov/national/marine-life-distress/deepwater-horizon-oil-spill-2010-sea-turtles-dolphins-and-whales.

National Marine Fisheries Service. (2014b). Endangered and Threatened Species: Critical Habitat for the Northwest Atlantic Ocean Loggerhead Sea Turtle Distinct Population Segment (DPS) and Determination Regarding Critical Habitat for the North Pacific Ocean Loggerhead DPS; Final Rule. *Federal Register, 79*(132), 39856–39912.

National Marine Fisheries Service, and U.S. Fish and Wildlife Service. (2015). *Kemp's Ridley Sea Turtle (Lepidochelys kempii) 5-Year Review: Summary and Evaluation*. Silver Spring, MD: National Marine Fisheries Service Office of Protected Resources and U.S. Fish and Wildlife Service Southwest Region.

National Marine Fisheries Service and U.S. Fish and Wildlife Service. (1992). *Recovery Plan for Leatherback Turtles (Dermochelys coriacea) in the U.S. Caribbean, Atlantic and Gulf of Mexico*. Silver Spring, MD: National Marine Fisheries Service.

National Ocean Service. (2016). *Where Are Reef Building Corals Found*. Retrieved from http://oceanservice.noaa.gov/education/tutorial_corals/coral05_distribution.html.

National Oceanic and Atmospheric Administration. (2015). *2015 Annual Report to a Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in U.S. Waters of the Western North Atlantic Ocean–AMAPPS II*. Woods Hole, MA and Miami, FL: Northeast Fisheries Science Center and Southeast Fisheries Science Center.

National Park Service. (2012). *Everglades National Park, American Alligator: Species Profile*. Retrieved from http://www.nps.gov/ever/naturescience/alligator.htm.

Nifong, J. C., and B. Silliman. (2017). Abiotic factors influence the dynamics of marine habitat use by a highly mobile "freshwater" top predator. *Hydrobiologia, 802*(1), 155–174.

O'Hara, J., and J. R. Wilcox. (1990). Avoidance responses of loggerhead turtles, *Caretta caretta*, to low frequency sound. *Copeia, 1990*(2), 564–567.

O'Keeffe, D. J., and G. A. Young. (1984). *Handbook on the Environmental Effects of Underwater Explosions*. Silver Spring, MD: U.S. Navy, Naval Surface Weapons Center (Code R14).

Office of the Surgeon General. (1991). Conventional Warfare Ballistic, Blast, and Burn Injuries. In R. Zajitchuk, Col. (Ed.), *U.S.A. Textbook of Military Medicine*. Washington, DC: Office of the Surgeon General.

Oros, J., A. Torrent, P. Calabuig, and S. Deniz. (2005). Diseases and causes of mortality among sea turtles stranded in the Canary Islands, Spain (1998–2001). *Diseases of Aquatic Organisms, 63*, 13–24.

Ortmann, A. C., J. Anders, N. Shelton, L. Gong, A. G. Moss, and R. H. Condon. (2012). Dispersed oil disrupts microbial pathways in pelagic food webs. *PLoS ONE, 7*(7), e42548.

Outerbridge, M. E., R. M. O'Riordan, T. Quirke, and J. Davenport. (2017). Restricted diet in a vulnerable native turtle, *Malaclemys terrapin* (Schoepff), on the oceanic islands of Bermuda. *Amphibian & Reptile Conservation, 11*(1), 25–35.

Pajuelo, M., K. A. Bjorndal, M. D. Arendt, A. M. Foley, B. A. Schroeder, B. E. Witherington, and A. B. Bolten. (2016). Long-term resource use and foraging specialization in male loggerhead turtles. *Marine Biology, 163*(11), 235.

Parker, L. G. (1995). Encounter with a juvenile hawksbill turtle offshore Sapelo Island, Georgia. *Marine Turtle Newsletter, 71*, 19–22.

Patino-Martinez, J., A. Marco, L. Quinones, and B. Godley. (2008). Globally significant nesting of the leatherback turtle (*Dermochelys coriacea*) on the Caribbean coast of Colombia and Panama. *Biological Conservation, 141*(8), 1982–1988.

Patrício, A. R., C. E. Diez, R. P. Van Dam, and B. J. Godley. (2016). Novel insights into the dynamics of green turtle fibropapillomatosis. *Marine Ecology Progress Series, 547*, 247–255.

Patrício, R., C. E. Diez, and R. P. Van Dam. (2014). Spatial and temporal variability of immature green turtle abundance and somatic growth in Puerto Rico. *Endangered Species Research, 23*(1), 51–62.

Peña, J. (2006). *Plotting Kemp's Ridleys, plotting the future of sea turtle conservation* (SWoT Report). Washington, DC: The State of the World's Sea Turtles.

Pepper, C. B., M. A. Nascarella, and R. J. Kendall. (2003). A review of the effects of aircraft noise on wildlife and humans, current control mechanisms, and the need for further study. *Environmental Management, 32*(4), 418–432.

Pfau, B., and W. M. Roosenburg. (2010). Diamondback terrapins in Maryland: Research and conservation. *Radiata, 19*, 2–34.

Pike, D. A. (2014). Forecasting the viability of sea turtle eggs in a warming world. *Global Change Biology, 20*(1), 7–15.

Pike, D. A., E. A. Roznik, and I. Bell. (2015). Nest inundation from sea-level rise threatens sea turtle population viability. *Royal Society Open Science, 2*(7), 150127.

Piniak, W. E. D., D. A. Mann, C. A. Harms, T. T. Jones, and S. A. Eckert. (2016). Hearing in the juvenile green sea turtle (*Chelonia mydas*): A comparison of underwater and aerial hearing using auditory evoked potentials. *PLoS ONE, 11*(10), e0159711.

Plotkin, P., and A. F. Amos. (1998). *Entanglement and Ingestion of Marine Turtles Stranded Along the South Texas Coast.* Paper presented at the Eighth Annual Workshop on Sea Turtle Conservation and Biology, Fort Fisher, NC.

Popper, A. N., A. D. Hawkins, R. R. Fay, D. A. Mann, S. M. Bartol, T. J. Carlson, S. Coombs, W. T. Ellison, R. L. Gentry, M. B. Halvorsen, S. Løkkeborg, P. H. Rogers, B. L. Southall, D. G. Zeddies, and W. N. Tavolga. (2014). *ASA S3/SC1.4 TR-2014 Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI*. New York, NY and London, United Kingdom: Acoustical Society of America Press and Springer Briefs in Oceanography.

Pritchard, P. C. H., and R. c. Marquez. (1973). *Kemp's ridley turtle or Atlantic ridley (Lepidochelys kempii)* (IUCN Monograph No. 2: Marine Turtle Series). Morges, Switzerland: International Union for Conservation of Nature and Natural Resources.

Putman, N. F., F. A. Abreu-Grobois, I. Iturbe-Darkistade, E. M. Putman, P. M. Richards, and P. Verley. (2015a). Deepwater Horizon oil spill impacts on sea turtles could span the Atlantic. *Biology letters, 11*(12).

Putman, N. F., and K. L. Mansfield. (2015). Direct Evidence of Swimming Demonstrates Active Dispersal in the Sea Turtle "Lost Years". *Current Biology, 25*(9), 1221–1227.

Putman, N. F., P. Verley, C. S. Endres, and K. J. Lohmann. (2015b). Magnetic navigation behavior and the oceanic ecology of young loggerhead sea turtles. *Journal of Experimental Biology, 218*(7), 1044–1050.

Rabon, D. R., Jr., S. A. Johnson, R. Boettcher, M. Dodd, M. Lyons, S. Murphy, S. Ramsey, S. Roff, and K. Stewart. (2003). Confirmed leatherback turtle (*Dermochelys coriacea*) nests from North Carolina, with a summary of leatherback nesting activities north of Florida. *Marine Turtle Newsletter, 101*, 4–8.

Raytheon Company. (2015). *Airborne Mine Neutralization System (AMNS): Alternative Optical Fiber Engineering Study Final Report*. Portsmouth, RI: Integrated Defense Systems.

Reece, J. S., D. Passeri, L. Ehrhart, S. C. Hagen, A. Hays, C. Long, R. F. Noss, M. Bilskie, C. Sanchez, and M. V. Schwoerer. (2013). Sea level rise, land use, and climate change influence the distribution of loggerhead turtle nests at the largest U.S.A. rookery (Melbourne Beach, Florida). *Marine Ecology Progress Series, 493*, 259–274.

Renaud, M. L., and J. A. Carpenter. (1994). Movements and submergence patterns of loggerhead turtles (*Caretta caretta*) in the Gulf of Mexico determined through satellite telemetry. *Bulletin of Marine Science, 55*(1), 1–15.

Renaud, M. L., J. A. Carpenter, J. A. Williams, and S. A. Manzellatirpak. (1995). Activities of juvenile green turtles, *Chelonia mydas*, at a jettied pass in south Texas. *Fishery Bulletin, 93*(3), 586–593.

Renaud, M. L., J. A. Carpenter, J. A. Williams, and A. M. Landry, Jr. (1996). Kemp's ridley sea turtle (*Lepidochelys kempii*) tracked by satellite telemetry from Louisiana to nesting beach at Rancho Nuevo, Tamaulipas, Mexico. *Chelonian Conservation and Biology, 2*(1), 108–109.

Reneker, J. L., and S. J. Kamel. (2016). Climate change increases the production of female hatchlings at a northern sea turtle rookery. *Ecology, 97*(12), 3257–3264.

Rester, J., and R. Condrey. (1996). The occurrence of the hawksbill turtle, *Eretmochelys imbricata*, along the Louisiana coast. *Gulf of Mexico Science, 14*(2), 112–114.

Ribic, C. A., S. B. Sheavly, D. J. Rugg, and E. S. Erdmann. (2010). Trends and drivers of marine debris on the Atlantic coast of the United States 1997–2007. *Marine Pollution Bulletin 60*(8), 1231–1242.

Rice, M. R., and G. H. Balazs. (2008). Diving behavior of the Hawaiian green turtle (*Chelonia mydas*) during oceanic migrations. *Journal of Experimental Marine Biology and Ecology, 356*(1–2), 121–127.

Richardson, and McGillvary. (1991). *Proceedings of the Twenty-fourth Annual Symposium on Sea Turtle Biology and Conservation* (NOAA Technical Memorandum). Miami, FL: National Marine Fisheries Service.

Richardson, J. I., and P. McGillivary. (1991). Post-hatchling loggerhead turtles eat insects in *Sargassum* community. *Marine Turtle Newsletter, 55*, 2–5.

Richardson, W. J., C. R. Greene, Jr., C. I. Malme, and D. H. Thomson. (1995). *Marine Mammals and Noise*. San Diego, CA: Academic Press.

Richmond, D. R., J. T. Yelverton, and E. R. Fletcher. (1973). *Far-Field Underwater-Blast Injuries Produced by Small Charges*. Washington, DC: Lovelace Foundation for Medical Education and Research, Defense Nuclear Agency.

Ridgway, S. H., E. G. Wever, J. G. McCormick, J. Palin, and J. H. Anderson. (1969). Hearing in the giant sea turtle, *Chelonia mydas*. *Proceedings of the National Academy of Sciences U.S.A., 64*(3), 884–890.

Roberts, M. A., C. J. Anderson, B. Stender, A. Segars, J. D. Whittaker, J. M. Grady, and J. M. Quattro. (2005). Estimated contribution of Atlantic coastal loggerhead turtle nesting populations to offshore feeding aggregations. *Conservation Genetics, 6*, 133–139.

Robinson, N. J., S. E. Valentine, P. Santidrián Tomillo, V. S. Saba, J. R. Spotila, and F. V. Paladino. (2013). Multidecadal trends in the nesting phenology of Pacific and Atlantic leatherback turtles are associated with population demography. *Endangered Species Research, 24*, 197–206.

Rochford, M. R., K. L. Krysko, F. J. Mazzotti, M. H. Shirley, M. W. Parry, J. A. Wasilewski, J. S. Beauchamp, C. R. Gillette, E. F. Metzger, III, and M. A. Squires. (2016). Molecular analyses confirming the introduction of Nile crocodiles, *Crocodylus niloticus* Laurenti 1768 (Crocodylidae), in southern Florida, with an assessment of potential for establishment, spread, and impacts. *Herpetological Conservation and Biology, 11*(1), 80–89.

Roosenburg, W. M., W. Cresko, M. Modesitte, and M. B. Robbins. (1997). Diamondback terrapin (*Malaclemys terrapin*) mortality in crab pots. *Conservation Biology, 11*(5), 1166–1172.

Rosen, G., and G. R. Lotufo. (2010). Fate and effects of composition B in multispecies marine exposures. *Environmental Toxicology and Chemistry, 9999*(12), 1–8.

Rosenblatt, A. E., J. C. Nifong, M. R. Heithaus, F. J. Mazzotti, M. S. Cherkiss, B. M. Jeffery, R. M. Elsey, R. A. Decker, B. R. Silliman, and L. J. Guillette. (2015). Factors affecting individual foraging specialization and temporal diet stability across the range of a large “generalist” apex predator. *Oecologia, 178*(1), 5–16.

Rosman, I., G. S. Boland, L. Martin, and C. Chandler. (1987). *Underwater Sightings of Sea Turtles in the Northern Gulf of Mexico*. (OCS Study MMS 87-0107). Bryan, TX: U.S. Department of the Interior, Minerals Management Service.

Russell, D. J., and G. H. Balazs. (2015). Increased use of non-native algae species in the diet of the green turtle (*Chelonia mydas*) in a primary pasture ecosystem in Hawaii. *Aquatic Ecosystem Health & Management, 18*(3), 342–346.

Sakamoto, W., K. Sato, H. Tanaka, and Y. Naito. (1993). Diving patterns and swimming environment of two loggerhead turtles during internesting. *Nippon Suisan Gakkaishi, 59*(7), 1129–1137.

Salmon, M., T. T. Jones, and K. W. Horch. (2004). Ontogeny of diving and feeding behavior in juvenile seaturtles: Leatherback seaturtles (*Dermochelys coriacea* L) and green seaturtles (*Chelonia mydas* L) in the Florida current. *Journal of Herpetology, 38*(1), 36–43.

Salmon, M., M. Reising, and S. Stapleton. (2016). The Evolution of Hatchling Morphology. *Marine Turtle Newsletter*(149), 9.

Sampson, L., and A. Giraldo. (2014). Annual abundance of salps and doliolids (*Tunicata*) around Gorgona Island (Colombian Pacific), and their importance as potential food for green sea turtles. *Revista de Biología Tropical, 62*, 149–159.

Sasso, C. R., and W. N. Witzell. (2006). Diving behaviour of an immature Kemp's ridley turtle (*Lepidochelys kempii*) from Gullivan Bay, Ten Thousand Islands, southwest Florida. *Journal of the Marine Biological Association of the United Kingdom, 86*, 919–925.

Saunders, J. C., R. K. Duncan, D. E. Doan, and Y. L. Werner. (2000). The Middle Ear of Reptiles and Birds. In Dooling R.J., Fay R.R., & Popper A.N. (Eds.), *Comparative Hearing: Birds and Reptiles* (Vol. 13, pp. 13–69). New York, NY: Springer.

Savannah River Ecology Laboratory, and Herpetology Program. (2012). *Species Profile: American Alligator (Alligator mississippiensis)*. Retrieved from http://srelherp.uga.edu/alligators/allmis.htm.

Schofield, G., V. J. Hobson, M. K. S. Lilley, K. A. Katselidis, C. M. Bishop, P. Brown, and G. C. Hays. (2010). Inter-annual variability in the home range of breeding turtles: Implications for current and future conservation management. *Biological Conservation, 143*(3), 722–730.

Schroeder, B. A., and N. B. Thompson. (1987). *Distribution of the Loggerhead Turtle, Caretta caretta, and the Leatherback Turtle, Dermochelys coriacea, in the Cape Canaveral, Florida Area: Results of Aerial Surveys*. (National Oceanic and Atmospheric Administration Technical Report National Marine Fisheries Service 53). Miami, FL: U.S. Department of Commerce, National Oceanic and Atmospheric Administration.

Schroeder, B. A., A. M. Foley, and D. A. Bagley. (2003). Nesting patterns, reproductive migrations, and adult foraging areas of loggerhead turtles. In A. B. Bolten & B. E. Witherington (Eds.), *Loggerhead Sea Turtles* (pp. 114–124). Washington, DC: Smithsonian Institution Press.

Schuyler, Q., B. D. Hardesty, C. Wilcox, and K. Townsend. (2014). Global analysis of anthropogenic debris ingestion by sea turtles. *Conservation Biology, 28*(1), 129–139.

Schuyler, Q. A., C. Wilcox, K. A. Townsend, K. R. Wedemeyer-Strombel, G. Balazs, E. Sebille, and B. D. Hardesty. (2016). Risk analysis reveals global hotspots for marine debris ingestion by sea turtles. *Global Change Biology, 22*(2), 567–576.

Schwartz, F. J. (1989). *Zoogeography and Ecology of Fishes Inhabiting North Carolina's Marine Waters to Depths of 600 Meters*. Silver Spring, MD: National Oceanic and Atmospheric Administration.

Seminoff, J. A., A. Resendiz, and W. J. Nichols. (2002). Home range of green turtles, *Chelonia mydas,* at a coastal foraging area in the Gulf of California, Mexico. *Marine Ecology Progress Series, 242*, 253–265.

Seminoff, J. A., and Marine Turtle Specialist Group Green Turtle Task Force. (2004). *Marine Turtle Specialist Group Review: 2004 Global Status Assessment, Green turtle (Chelonia mydas)*. Gland, Switzerland: The World Conservation Union (IUCN) Species Survival Commission, Red List Programme.

Seminoff, J. A., C. D. Allen, G. H. Balazs, P. H. Dutton, T. Eguchi, H. L. Haas, S. A. Hargrove, M. P. Jensen, D. L. Klemm, A. M. Lauritsen, S. L. MacPherson, P. Opay, E. E. Possardt, S. L. Pultz, E. E. Seney, K. S. Van Houtan, and R. S. Waples. (2015). *Status Review of the Green Turtle (Chelonia mydas) Under the U.S. Endangered Species Act*. (NOAA Technical Memorandum NMFS-SWFSC-592). La Jolla, CA: Southwest Fisheries Science Center.

Seney, E. E. (2016). Diet of Kemp's ridley sea turtles incidentally caught on recreational fishing gear in the northwestern Gulf of Mexico. *Chelonian Conservation and Biology, 15*(1), 132–137.

Servis, J. A., G. Lovewell, and A. D. Tucker. (2015). Diet analysis of subadult Kemp's ridley (*Lepidochelys kempii*) turtles from west-central Florida. *Chelonian Conservation and Biology, 14*(2), 173–181.

Shaver, D. (2018). [Personnal communication from Donna Shaver to Taylor Houston containing PAIS sea turtle nesting data].

Shaver, D. J., and C. W. Caillouet, Jr. (1998). More Kemp's Ridley turtles return to South Texas to nest. *Marine Turtle Newsletter, 82*, 1–5.

Shaver, D. J., K. M. Hart, I. Fujisaki, C. Rubio, A. R. Sartain-Iverson, J. Peña, D. G. Gamez, R. J. G. D. Miron, P. M. Burchfield, and H. J. Martinez. (2016). Migratory corridors of adult female Kemp's ridley turtles in the Gulf of Mexico. *Biological Conservation, 194*, 158–167.

Sheridan, C. M., J. R. Spotila, W. F. Bien, and H. W. Avery. (2010). Sex-biased dispersal and natal philopatry in the diamondback terrapin, *Malaclemys terrapin*. *Molecular Ecology, 19*(24), 5497–5510.

Shine, R., X. Bonnet, M. J. Elphick, and E. G. Barrott. (2004). A novel foraging mode in snakes: Browsing by the sea snake *Emydocephalus annulatus* (Serpentes, Hydrophiidae). *Functional Ecology, 18*(1), 16–24.

Shoop, C. R., and R. D. Kenney. (1992). Seasonal distributions and abundances of loggerhead and leatherback sea turtles in waters of the northeastern United States. *Herpetological Monographs, 6*, 43–67.

Shute, C. C. D., and A. d. A. Bellairs. (1955). The external ear in Crocodilia. *Journal of Zoology, 124*(4), 741–749.

Smith, A., T. Stehly, and W. Musial. (2015). *2014 U.S. Offshore Wind Market Report: Industry Trends, Technology Advancement, and Cost Reduction*. Baltimore, MD: National Renewable Energy Laboratory.

Smith, C. E., S. T. Sykora–Bodie, B. Bloodworth, S. M. Pack, T. R. Spradlin, and N. R. LeBoeuf. (2016). Assessment of known impacts of unmanned aerial systems (UAS) on marine mammals: Data gaps and recommendations for researchers in the United States. *Journal of Unmanned Vehicle Systems, 4*(1), 31–44.

Smith, S. H., and D. E. Marx, Jr. (2016). De-facto marine protection from a Navy bombing range: Farallon de Medinilla, Mariana Archipelago, 1997 to 2012. *Marine Pollution Bulletin, 102*(1), 187–198.

Snoddy, J. E., M. Landon, G. Blanvillain, and A. Southwood. (2009). Blood biochemistry of sea turtles captured in gillnets in the lower Cape Fear River, North Carolina, USA. *Journal of Wildlife Management, 73*(8), 1394–1401.

Southern California Marine Institute. (2016). *Southern California Offshore Banks, National Marine Sanctuary Proposal*. Los Angeles, CA: Marine Institute and the Vantuna Research Group and Moore Laboratory of Zoology, Occidental College.

Southwood, A. L., R. D. Andrews, M. E. Lutcavage, F. V. Paladino, N. H. West, R. H. George, and D. R. Jones. (1999). Heart rates and diving behavior of leatherback sea turtles in the eastern Pacific Ocean. *The Journal of Experimental Biology, 202*, 1115–1125.

Spargo, B. J. (2007). [Personal Communication with Mark Collins Regarding Chaff End Cap and Piston Bouyancy].

Spotila, J. R., A. E. Dunham, A. J. Leslie, A. C. Steyermark, P. T. Plotkin, and F. V. Paladino. (1996). Worldwide population decline of *Dermochelys coriacea*: Are leatherback turtles going extinct? *Chelonian Conservation and Biology, 2*(2), 209–222.

Stabenau, E. K., T. A. Heming, and J. F. Mitchell. (1991). Respiratory, acid-base and ionic status of Kemp's ridley sea turtles (*Lepidochelys kempii*) subjected to trawling. *Comparative Biochemistry and Physiology Part A: Physiology, 99*(1), 107–111.

Stewart, K., M. Sims, A. Meylan, B. Witherington, B. Brost, and L. B. Crowder. (2011). Leatherback nests increasing significantly in Florida, USA; Trends assessed over 30 years using multilevel modeling. *Ecological Applications, 21*(1), 263–273.

Stewart, K. R., K. J. Martin, C. Johnson, N. Desjardin, S. A. Eckert, and L. B. Crowder. (2014). Increased nesting, good survival and variable site fidelity for leatherback turtles in Florida, USA. *Biological Conservation, 176*, 117–125.

Stewart, K. R., E. L. LaCasella, S. E. Roden, M. P. Jensen, L. W. Stokes, S. P. Epperly, and P. H. Dutton. (2016). Nesting population origins of leatherback turtles caught as bycatch in the US pelagic longline fishery. *Ecosphere, 7*(3), 1–18.

Swingle, W. M., S. G. Barco, E. B. Bates, G. G. Lockhart, K. M. Phillips, K. R. Rodrique, S. A. Rose, and K. M. Williams. (2016). *Virginia Sea Turtle and Marine Mammal Stranding Network 2015 Grant Report*. Virginia Beach, VA: Virginia Aquarium Foundation.

Swisdak, M. M., Jr., and P. E. Montanaro. (1992). *Airblast and Fragmentation Hazards Produced by Underwater Explosions*. Silver Spring, MD: Naval Surface Warfare Center.

Swope, B., and J. McDonald. (2013). *Copper-Based Torpedo Guidance Wire: Applications and Environmental Considerations*. San Diego, CA: Space and Naval Warfare Systems Command Center Pacific.

Teuten, E. L., S. J. Rowland, T. S. Galloway, and R. C. Thompson. (2007). Potential for plastics to transport hydrophobic contaminants. *Environmental Science and Technology, 41*(22), 7759–7764.

Thorbjarnarson, J., F. Mazzotti, E. Sanderson, F. Buitrago, M. Lazcano, K. Minkowski, M. Muniz, P. Ponce, L. Sigler, R. Soberon, A. M. Trelancia, and A. Velasco. (2006). Regional habitat conservation priorities for the American crocodile. *Biological Conservation, 128*(1), 25–36.

Tucker, A. D., B. D. MacDonald, and J. A. Seminoff. (2014). Foraging site fidelity and stable isotope values of loggerhead turtles tracked in the Gulf of Mexico and Northwest Caribbean. *Marine Ecology Progress Series, 502*, 267–279.

Tulipani, D. C., and R. N. Lipcius. (2014). Evidence of eelgrass (*Zostera marina*) seed dispersal by northern diamondback terrapin (*Malaclemys terrapin terrapin*) in lower Chesapeake Bay. *PLoS ONE, 9*(7), e103346.

Turtle Expert Working Group. (2007). *An assessment of the leatherback turtle population in the Atlantic Ocean*. Miami, FL: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service and Southeast Fisheries Science Center.

U.S. Air Force. (1997). *Environmental Effects of Self-Protection Chaff and Flares - Final Report*. Langley Air Force Base, VA: U.S. Air Force, Headquarters Air Combat Command.

U.S. Department of the Navy. (1996). *Environmental Assessment of the Use of Selected Navy Test Sites for Development Tests and Fleet Training Exercises of the MK-46 and MK-50 Torpedoes*. Pearl Harbor, HI: United States Command Pacific Fleet.

U.S. Department of the Navy. (1999). *Environmental Effects of RF Chaff: A Select Panel Report to the Undersecretary of Defense for Environmental Security*. Washington, DC: U.S. Department of the Navy, Naval Research Laboratory.

U.S. Department of the Navy. (2005). *Final Environmental Assessment and Overseas Environmental Assessment for Organic Airborne and Surface Influence Sweep Mission Tests*. Washington, DC: Airborne Mine Defense Program Office, Program Executive Office: Littoral and Mine Warfare.

U.S. Department of the Navy. (2013). *Water Range Sustainability Environmental Program Assessment: Potomac River Test Range*. Dahlgren, VA: Naval Surface Warfare Center.

U.S. Department of the Navy. (2017). *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)*. San Diego, CA: Space and Naval Warfare System Command, Pacific.

U.S. Department of the Navy. (2018). *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (Technical Report prepared by NUWC Division Newport, Space and Naval Warfare Systems Center Pacific, G2 Software Systems, and the National Marine Mammal Foundation). Newport, RI: Naval Undersea Warfare Center.

U.S. Fish and Wildlife Service. (2010). *Species Profile: American crocodile Crocodylus acutus*. Retrieved from https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=C02J.

United Nations Environmental Program. (2005). *Marine Litter: An analytical overview*. Nairobi, Kenya: United Nations Environment Programme's Regional Seas Programme.

University of Georgia. (2017). *Diamondback Terrapin (Malaclemys terrapin)*. Retrieved from https://srelherp.uga.edu/turtles/malter.htm.

Urick, R. J. (1983). *Principles of Underwater Sound* (3rd ed.). Los Altos, CA: Peninsula Publishing.

Valverde, R. A., D. W. Owens, D. S. MacKenzie, and M. S. Amoss. (1999). Basal and stress-induced corticosterone levels in olive ridley sea turtles (*Lepidochelys olivacea*) in relation to their mass nesting behavior. *Journal of Experimental Zoology, 284*(6), 652–662.

Van Houtan, K. S., D. L. Francke, S. Alessi, T. T. Jones, S. L. Martin, L. Kurpita, C. S. King, and R. W. Baird. (2016). The developmental biogeography of hawksbill sea turtles in the North Pacific. *Ecology and Evolution, 6*(8), 2378–2389.

Vergne, A. L., M. B. Pritz, and N. Mathevon. (2009). Acoustic communication in crocodilians: From behaviour to brain. *Biological Reviews, 84*, 391–411.

Verkaik, K., J. Hamel, and A. Mercier. (2016). Carry-over effects of ocean acidification in a cold-water lecithotrophic holothuroid. *Marine Ecology Progress Series, 557*, 189–206.

Viada, S. T., R. M. Hammer, R. Racca, D. Hannay, M. J. Thompson, B. J. Balcom, and N. W. Phillips. (2008). Review of potential impacts to sea turtles from underwater explosive removal of offshore structures. *Environmental Impact Assessment Review, 28*, 267–285.

Vliet, K. A. (1989). Social displays of the American alligator. *American Zoology, 29*, 1019–1031.

Vliet, K. A. (2001). Courtship behaviour of American alligators, *Alligator mississippiensis*. In G. C. Grigg, F. Seebacher, & C. E. Franklin (Eds.), *Crocodilian Biology and Evolution* (pp. 383–408). Baulkham Hills, Australia: Surrey Beatty & Sons.

Votier, S. C., K. Archibald, G. Morgan, and L. Morgan. (2011). The use of plastic debris as nesting material by a colonial seabird and associated entanglement mortality. *Marine Pollution Bulletin, 62*(1), 168–172.

Wallace, B. P., A. D. DiMatteo, B. J. Hurley, E. M. Finkbeiner, A. B. Bolten, M. Y. Chaloupka, B. J. Hutchinson, F. A. Abreu-Grobois, D. Amorocho, K. A. Bjorndal, J. Bourjea, B. W. Bowen, R. B. Duenas, P. Casale, B. C. Choudhury, A. S. Costa, P. H. Dutton, A. Fallabrino, A. Girard, M. Girondot, M. H. Godfrey, M. Hamann, M. Lopez-Mendilaharsu, M. A. Marchovaldi, J. A. Mortimer, J. A. Musick, R. Nel, N. J. Pitcher, J. A. Seminoff, S. Troeng, B. Witherington, and R. B. Mast. (2010a). Regional Management Units for Marine Turtles: A Novel Framework for Prioritizing Conservation and Research across Multiple Scales. *PLoS ONE, 5*(12), e15465.

Wallace, B. P., R. L. Lewison, S. L. McDonald, R. K. McDonald, C. Y. Kot, S. Kelez, R. K. Bjorkland, E. M. Finkbeiner, S. Helmbrecht, and L. B. Crowder. (2010b). Global patterns of marine turtle bycatch. *Conservation Letters, 3*(3), 131–142.

Wallace, B. P., M. Zolkewitz, and M. C. James. (2015). Fine-scale foraging ecology of leatherback turtles. *Frontiers in Ecology and Evolution, 3*, 15.

Walters, T. M., F. J. Mazzotti, and H. C. Fitz. (2016). Habitat selection by the invasive species Burmese python in southern Florida. *Journal of Herpetology, 50*(1), 50–56.

Watson, T. K., K. Hoomanawanui, R. Thurman, B. Thao, and K. Boyne. (2017). *Na Ikena I Kai (Seaward Viewsheds): Inventory of Terrestrial Properties for Assessment of Marine Viewsheds on the Eight MAin HAwaiian Islands*. Camarillo, CA.

Watwood, S. L., J. D. Iafrate, E. A. Reyier, and W. E. Redfoot. (2016). Behavioral Response of Reef Fish and Green Sea Turtles to Mid-Frequency Sonar. In A. N. Popper & A. Hawkins (Eds.), *The Effects of Noise on Aquatic Life II* (pp. 1213–1221). New York, NY: Springer.

Weaver, J. P., D. Rodriguez, M. Venegas-Anaya, J. R. Cedeño-Vázquez, M. R. J. Forstner, and L. D. Densmore. (2008). Genetic characterization of captive Cuban crocodiles (*Crocodylus rhombifer*) and evidence of hybridization with the American crocodile (*Crocodylus acutus*). *Journal of Experimental Zoology Part A: Ecological Genetics and Physiology, 309*(10), 649–660.

Weber, M. (1995). *Kemp's Ridley Sea Turtle, Lepidochelys kempii*. Silver Spring, MD: National Marine Fisheries Service.

Weir, C. R. (2007). Observations of marine turtles in relation to seismic airgun sound off Angola. *Marine Turtle Newsletter, 116*, 17–20.

Weishampel, J. F., D. A. Bagley, and L. M. Ehrhart. (2006). Intra-annual loggerhead and green turtle spatial nesting patterns. *Southeastern Naturalist, 5*(3), 453–462.

Wever, E. G. (1971). Hearing in the Crocodilia. *Proceedings of the National Academy of Sciences U.S.A., 68*, 1498–1500.

Wheatley, P. V., H. Peckham, S. D. Newsome, and P. L. Koch. (2012). Estimating marine resource use by the American crocodile, *Crocodylus acutus*, in southern Florida, U.S.A. *Marine Ecology-Progress Series, 447*, 211–229.

Wiley, M. L., J. B. Gaspin, and J. F. Goertner. (1981). Effects of underwater explosions on fish with a dynamical model to predict fishkill. *Ocean Science and Engineering, 6*(2), 223–284.

Wilkin, S. M., T. K. Rowles, E. Stratton, N. Adimey, C. L. Field, S. Wissman, G. Shigenaka, E. Fougeres, B. Mase, Southeast Region Stranding Network, and M. H. Ziccardi. (2017). Marine mammal response operations during the *Deepwater Horizon* oil spill. *Endangered Species Research, 33*, 107–118.

Williams-Walls, N., J. O'Hara, R. M. Gallagher, D. F. Worth, B. D. Peery, and J. R. Wilcox. (1983). Spatial and temporal trends of sea turtle nesting on Hutchinson Island, Florida, 1971–1979. *Bulletin of Marine Science, 33*(1), 55–66.

Williams, K. A., I. J. Stenhouse, E. E. Connelly, and S. M. Johnson. (2015). *Mid-Atlantic Wildlife Studies: Distribution and Abundance of Wildlife along the Eastern Seaboard 2012–2014* (Science Communications Series BRI 2015-19). Portland, ME: Biodiversity Research Institute.

Willis, K. L., J. Christensen-Dalsgaard, D. R. Ketten, and C. E. Carr. (2013). Middle ear cavity morphology is consistent with an aquatic origin for testudines. *PLoS ONE, 8*(1), e54086.

Witherington, B., and S. Hirama. (2006). Sea turtles of the epi-pelagic *Sargassum* drift community. In M. Frick, A. Panagopoulou, A. F. Rees, & K. Williams (Eds.), *Book of Abstracts. Twenty-sixth Annual Symposium on Sea Turtle Biology and Conservation* (pp. 209). Athens, Greece: International Sea Turtle Society.

Witt, M. J., L. A. Hawkes, M. H. Godfrey, B. J. Godley, and A. C. Broderick. (2010). Predicting the impacts of climate change on a globally distributed species: The case of the loggerhead turtle. *The Journal of Experimental Biology, 213*(6), 901–911.

Witzell, W. N. (1983). *Synopsis of biological data on the hawksbill turtle, Eretmochelys imbricata (Linnaeus, 1766)*. Rome, Italy: United Nations Environment Programme, Food and Agriculture Organization of the United Nations.

Work, T. M., and G. H. Balazs. (2013). Tumors in sea turtles: The insidious menace of fibropapillomatosis. *The Wildlife Professional*, 44–47.

Wright, A. J., and L. A. Kyhn. (2015). Practical management of cumulative anthropogenic impacts with working marine examples. *Conservation Biology, 29*(2), 333–340.

Yagla, J., and R. Stiegler. (2003). *Gun blast noise transmission across the air-sea interface*. Paper presented at the 5th European Conference on Noise Control. Naples, Italy.

Yelverton, J. T., D. R. Richmond, E. R. Fletcher, and R. K. Jones. (1973). *Safe Distances From Underwater Explosions for Mammals and Birds*. Albuquerque, NM: Lovelace Foundation for Medical Education and Research.

Yelverton, J. T., and D. R. Richmond. (1981). *Underwater Explosion Damage Risk Criteria for Fish, Birds, and Mammals.* Paper presented at the 102nd Meeting of the Acoustical Society of America. Miami Beach, FL.

Final
Environmental Impact Statement/Overseas Environmental Impact Statement
Atlantic Fleet Training and Testing

TABLE OF CONTENTS

List of Figures

List of Tables

3.9 Birds and Bats

BIRDS AND BATS SYNOPSIS

The United States Department of the Navy (Navy) considered all potential stressors that birds and bats could potentially be exposed to from the Proposed Action. The following conclusions have been reached for the Preferred Alternative (Alternative 1):

- Acoustics: Navy training and testing activities have the potential to expose birds and bats to a variety of acoustic stressors. The exposure to underwater sounds by birds depends on the species and foraging method. Pursuit divers may remain underwater for minutes, increasing the chance of underwater sound exposure. The exposure to in-air sounds by birds and bats depends on the activity (in flight or on the water surface) and the proximity to the sound source. Because birds are less susceptible to both temporary and permanent threshold shift than mammals, unless very close to an intense sound source, responses by birds to acoustic stressors would likely be limited to short-term behavioral responses. Some birds may be temporarily displaced and there may be temporary increases in stress levels. Although individual birds may be impacted, population level impacts are not expected. Unlike other mammals, bats are not susceptible to temporary and permanent threshold shifts. Bats may be temporarily displaced during foraging, but would return shortly after the training or testing is complete. Although individual bats may be impacted, population level impacts are not expected.
- Explosives: Navy training and testing activities have the potential to expose birds and bats to explosions in the water, near the water surface, and in air. Sounds generated by most small underwater explosions are unlikely to disturb birds and bats above the water surface. However, if a detonation is sufficiently large or is near the water surface, birds and bats above the pressure released at the air-water interface could be injured or killed. Detonations in air could injure birds and bats while either in flight or at the water surface; however, detonations in air during anti-air warfare training and testing would typically occur at much higher altitudes where seabirds, migrating birds, and bats are less likely to be present. Detonations may attract birds to possible fish kills, which could cause bird mortalities or injuries if there are multiple detonations in a single event. An explosive detonation would likely cause a startle reaction, as the exposure would be brief and any reactions are expected to be short-term. Although a few individuals may experience long-term impacts and potential mortality, population-level impacts are not expected.
- Energy: The impact of energy stressors on birds and bats is expected to be negligible based on (1) the limited geographic area in which they are used, (2) the rare chance that an individual bird or bat would be exposed to these devices in use, and (3) the tendency of birds and bats to temporarily avoid areas of activity when and where the devices are in use. The impacts of energy stressors would be limited to individual cases where a bird or bat might become temporarily disoriented and change flight direction, or be injured. Although a small number of individuals may be impacted, the impact at the population level would be negligible.

Continued on the next page…

Continued from the previous page…

BIRDS AND BATS SYNOPSIS

- Physical Disturbance and Strikes: There is the potential for individual birds to be injured or killed by physical disturbance and strikes during training and testing. However, there would not be long-term species or population level impacts due to the vast area over which training and testing activities occur and the small size of birds and their ability to flee disturbance. Impacts to bats would be similar to, but less than, those described for birds since bat occurrence in the Study Area is relatively scant compared to birds and because bats are most active from dusk through dawn.
- Entanglement: Entanglement stressors have the potential to impact birds. However, the likelihood is low because the relatively small quantities of materials that could cause entanglement would be dispersed over very wide areas, often in locations or depth zones outside the range or foraging abilities of most birds. A small number of individuals may be impacted, but no effects at the population level would be expected. The possibility that an individual of an ESA-listed bird species would become entangled is remote due to their rarity and limited overlap with Navy activities. Since bats considered in this analysis do not occur in the water column and rarely occur at the water surface in the Study Area, few, if any, impacts to bats are anticipated from entanglement stressors.
- Ingestion: It is possible that persistent expended materials could be accidentally ingested by birds while they were foraging for natural prey items, though the probability of this event is low as (1) foraging depths of diving birds is generally restricted to the surface of the water or shallow depths, (2) the material is unlikely to be mistaken for prey, and (3) most of the material remains at or near the sea surface for a short length of time. No population-level effect to any bird species would be anticipated. Since bats considered in this analysis do not occur in the water column and rarely feed at the water surface in the Study Area, few, if any, impacts to bats are anticipated from ingestion stressors.
- Secondary: There would be relatively localized, temporary impacts from water quality (turbidity) which may alter foraging conditions, but no impacts on prey availability. Since bats considered in this analysis do not occur in the water column and rarely occur at the water surface in the Study Area, few, if any, impacts to bats are anticipated from secondary stressors.

3.9.1 Introduction

This chapter provides the analysis of potential impacts on birds and bats found in the Atlantic Fleet Training and Testing (AFTT) Study Area (Study Area). This section provides an introduction to the species that occur in the Study Area.

The affected environment provides the context for evaluating the effects of the Navy training and testing activities to birds and bats. Because birds occur throughout the Study Area along shorelines, on the surface of the water, in water column and shallow bottom habitats, and are airborne over these habitats, Navy activities within these habitats could potentially impact many individuals and species, including members of diverse taxonomic groups, Endangered Species Act (ESA)-listed species, species protected under the Migratory Bird Treaty Act, and U.S. Fish and Wildlife Service (USFWS) Birds of Conservation Concern. Since bats also occur throughout the Study Area along shorelines, on or near the surface of the water, and are airborne over these habitats, Navy activities could affect bats in a similar manner. Any such impact, however, would be smaller than that to birds since bats are much less abundant in the Study Area compared to birds.

The following sections include Section 3.9.2 (Affected Environment), which provides a description of baseline conditions and brief introduction to the species and major taxonomic groups that occur in the Study Area; Section 3.9.3 (Environmental Consequences); and Section 3.9.4 (Summary of Potential Impacts on Birds and Bats). Throughout this chapter, particular consideration is given to ESA-listed species, species protected under the Migratory Bird Treaty Act, and the USFWS Birds of Conservation Concern.

3.9.2 Affected Environment

Three subsections are included in this section. General background information is given in Section 3.9.2.1 (General Background), which provides brief summaries of group size, habitat use, dive behavior, hearing and vocalization, and threats that affect or have the potential to affect natural communities of birds or bats within the Study Area. Protected species listed under the ESA are described in Section 3.9.2.2 (Endangered Species Act-Listed Species). Section 3.9.2.3 (Species Not Listed Under the Endangered Species Act) describes birds and bats not listed under the ESA, including major taxonomic groups and migratory birds protected under the Migratory Bird Treaty Act.

3.9.2.1 General Background

There are at least 160 species of birds that regularly occur in the Study Area (Sibley, 2014). Most of these are waterbirds – birds that live in marine, estuarine, and freshwater habitats. Waterbirds include seabirds, wading birds, shorebirds, and waterfowl, as described in more detail below. The remainder of species that may be regularly encountered in the Study Area are landbirds that are coastal resident species that live on land but forage in the adjacent coastal and inshore waters. Many more species (primarily songbirds) are neotropical migrants that occur briefly during transit between breeding areas in eastern North America and wintering areas in Central and South America and the Caribbean. Trans-Gulf migrants [birds that fly 600 miles across the Gulf of Mexico between the Yucatan Peninsula and the U.S. Gulf Coast (Texas to Florida)], passing through the Study Area, include at least 73 species of landbirds (Shackelford et al., 2005).

Seabirds – birds that forage primarily on the open ocean – are of particular interest as the group of birds with the broadest distribution and exposure to Navy activities in the Study Area. Seabirds are a diverse group that are adapted to living in marine environments (Enticott & Tipling, 1997) and use coastal (nearshore) waters, offshore waters (continental shelf), or open ocean areas (Harrison, 1983). There are many biological, physical, and behavioral adaptations that are different for seabirds than for terrestrial birds. Seabirds typically live longer, breed later in life, and produce fewer young than other bird species (Onley & Scofield, 2007). The feeding habits of seabirds are related to their individual physical characteristics, such as body mass, bill shape, and wing area (Hertel & Ballance, 1999). Some seabirds look for food (forage) on the sea surface, whereas others dive to variable depths to obtain prey (Burger, 2001). Many seabirds spend most of their lives at sea and come to land only to breed, nest, and occasionally rest (Schreiber & Chovan, 1986). Most species nest in groups (colonies) on the ground of coastal areas or oceanic islands, where breeding colonies number from a few individuals to thousands.

However, some species of seabirds and many other waterbird species are distributed nesters, and some are cavity nesters. Typical bird behavior to be encountered within the Study Area would include breeding, foraging, roosting, and migration. Beaches and wetlands within or bordering the Study Area may also be used as molting grounds by some species.

Additional information on the biology, life history, and conservation of bird species, including species-specific descriptions, is available from the websites of these sources:

- USFWS Migratory Bird Program and Endangered Species Program
- Birdlife International
- International Union for Conservation of Nature and Natural Resources Red List of Threatened Species
- National Audubon Society
- The Waterbird Society
- Department of Defense's (DoD) Partners in Flight
- Birds of North America

Bats include resident and migratory, hibernating and non-hibernating species (National Park Service, 2017a). Although all bats are terrestrial, many bat species occur in coastal (nearshore) waters, offshore waters (continental shelf), or open ocean areas while migrating or foraging and will use islands, ships, and other offshore structures as opportunistic or deliberate stopover sites for resting or roosting (Constantine, 2003; Cryan & Brown, 2007; Pelletier et al., 2013; Thompson et al., 2015; U.S. Department of Energy, 2016). While bats are typically nocturnal, there are anecdotal accounts of migratory tree bats (*Lasiurus* and *Lasionycteris* spp.) traveling during autumn migration in diurnal flocks (Hatch et al., 2013). In North America, bats almost exclusively use echolocation to navigate and feed on insects (Kunz, 2017).

Additional information on the biology, life history, and conservation of bat species is available from the websites of these sources:

- International Union for Conservation of Nature Red List of Threatened Species
- Bat Conservation International
- North American Bat Monitoring Program
- North American Bat Conservation Alliance
- North American Society for Bat Research

The following sections contain additional information on group size, habitat use, dive behavior, hearing and vocalization, and general threats for birds and bats in the Study Area.

3.9.2.1.1 Group Size

A variety of bird group sizes and diversity of species may be encountered throughout the Study Area, ranging from the solitary migration of an individual bird to thousands of birds in single-species and mixed-species flocks. Depending on season, location, and time of day, the number of birds observed (group size) will vary and will likely fluctuate from year to year. During spring and fall periods, diurnal and nocturnal migrants would likely occur in large groups as they migrate over open water. Many waterbirds migrate in very small groups or pairs, and then can be found in large groups at stopover areas and wintering grounds (Elphick, 2007).

Avian radar studies at sea show nocturnal migrants as well as seabirds moving across open oceans in large numbers (Desholm et al., 2006; Gauthreaux & Belser, 2003). During the nesting and breeding season, pelagic seabirds could be encountered in large groups following the currents and upwellings in pursuit of prey (Sibley, 2014). In the nearshore environments, terns, gulls, shorebirds, and plovers may occur in large groups while in their breeding and feeding areas.

Many bird species forage in large groups on shoaling fish or on concentrations of molluscs attached to the seafloor. Water temperatures, currents, upwellings, wind direction, and ocean floor topography can all influence when, where, and how many seabirds forage, and patterns of distribution and abundance vary from year to year (Elphick, 2007; Fauchald et al., 2002).

Depending on season, location, and time of day, the number of bats observed (group size) in the Study Area will vary and will likely fluctuate from year to year, ranging from solitary migration or foraging of an individual bat to single-species flocks (Constantine, 2003; Pelletier et al., 2013; U.S. Department of Energy, 2016). Bats flying over the ocean and other parts of the Study Area would most likely occur as single or a small number of individuals. No communal roosts or other large concentrations of bats are known within the Study Area.

3.9.2.1.2 Habitat Use

The Study Area includes portions of three major bird migration routes or flyways (Elphick, 2007) (Shackelford et al., 2005): the Atlantic, Mississippi, and Central flyways. The Atlantic Flyway includes an oceanic route which passes directly over the Atlantic Ocean from Labrador and Nova Scotia to the Lesser Antilles and mainland South America; and a coastal route that follows the coast between New England and Florida and continues across the Caribbean to South America. Over water routes used by many species to cross the Gulf of Mexico between mainland Mexico and the Gulf coast from Florida to Texas encompass the Mississippi Flyway and part of the Central Flyway. These routes overlap all of the large marine ecosystems detailed in Section 3.0.2.1 (Biogeographic Classifications). Many migratory song- and shorebirds fly close to the coastline of the Atlantic Flyway, although large numbers of seabirds and a few species of shore- and songbirds follow the oceanic flyway further offshore (throughout this section, offshore refers to areas beyond the immediate nearshore coastal areas both within and outside of the continental shelf). The largest numbers of neotropical migrants fly across the Gulf of Mexico at the southern end of the Mississippi Flyway (Elphick, 2007; Shackelford et al., 2005).

Birds forage in a variety of habitats such as coastal wetlands, estuaries, kelp beds, lagoons, and in the intertidal zone, as well as nearshore (immediately adjacent to the coastline) in shallower waters, and on the open ocean where they catch prey near or at the ocean surface. When and where birds occur is highly dependent on environmental factors and life stage and varies with prey location and time of year. Due to the uneven distribution of prey within the marine environment, some seabirds must fly long distances to obtain food. Other species like neotropical migrants must fly across open water twice a year to reach their wintering or breeding grounds in the search for food (Elphick, 2007; Shackelford et al., 2005).

Within the Study Area, species diversity of foraging seabirds is higher in the southern and lower in the northern portions of the Study Area (Karpouzi et al., 2007). Though the northern temperate regions have low species diversity, seabird densities and the amount of prey consumed are greater, due to overall higher productivity of northern waters (Karpouzi et al., 2007). Species particularly abundant in the northwest Atlantic include breeding auks in west Greenland; breeding Leach's storm-petrels (*Oceanodroma leucorhoa*) and northern gannets (*Morus bassanus*) in Newfoundland; and nonbreeding shearwaters and sea ducks in Eastern Newfoundland, Labrador, Gulf of St Lawrence, Scotian Shelf, and Gulf of Maine to Cape Hatteras (Barrett et al., 2006). Most seabirds forage in offshore waters over the continental shelves of North America (Karpouzi et al., 2007).

Bats are wide-ranging, occurring on many islands and every continent except for Antarctica. The vast majority of bat species occur in tropical regions; of the more than 1,100 species known world-wide, 44 species occur in the United States and Canada (Kunz, 2017). While all bats are terrestrial, numerous studies have shown that many species will forage within or migrate over marine environments, sometimes at considerable distances from shore. Hatch et al. (2013), for example, reported that offshore bats observed were located between 16.9 and 41.9 kilometers (km) from shore (with an average distance of 30 km) and that historic observations ranged from 2.9 to 1,950 km offshore (with an average distance of 103.6 km). Several North American bats have been found on Bermuda, located approximately 670 miles (mi.) (1,078 km) from the coast of the U.S. (Constantine, 2003; Pelletier et al., 2013). Thompson et al. (2015) reported a large flock of little brown bats (*Myotis lucifugus*) roosting on a ship and buoys approximately 68 mi. (110 km) off the coast of Maine during optimal summertime conditions, with warm air and no wind. While resident bats occur in marine environments, migratory bats – particularly long-distance migratory bats – are the most likely species to be observed in the Study Area (Bureau of Ocean Energy Management, 2013; Pelletier et al., 2013; U.S. Department of Energy, 2016). One study found that the eastern red bat (*Lasiurus borealis*) (73% of all occurrences) and hoary bat (*Lasiurus cinereus*) (22% of all occurrences) were the most likely species to be detected at buoy monitoring sites (U.S. Department of Energy, 2016), perhaps because they prefer open areas (Tetra Tech Inc, 2016d). Occurrence in a given area over the open ocean, however, is infrequent and seasonal, occurring most frequently during summer, particularly when the air is warm, the humidity is high, the wind speed is low, and when near forested land (Ahlén et al., 2009; Bureau of Ocean Energy Management, 2013; Johnson et al., 2011; U.S. Department of Energy, 2016).

Several studies have shown that bats typically fly close to the water's surface (e.g., lower than 10 meters [m] above sea level) when flying over water (Pelletier et al., 2013). However, many of these studies have had a limited ability to detect bats migrating at higher altitudes. Aerial surveys for bats, using high-definition video cameras mounted on a small aircraft at 610 m, off the Mid-Atlantic coast, revealed that, "of the six bats observed during aerial surveys for which flight height was estimable, all six were at altitudes over 100 m above sea level and five of the six were over 200 m" above sea level (Hatch et al. (2013).

3.9.2.1.3 Dive Behavior

Many of the seabird species found in the Study Area will dive, skim, or grasp prey at the water's surface or within the upper portion (1 to 2 m) of the water column (Cook et al., 2011; Jiménez et al., 2012). However, numerous seabirds, including various species of diving ducks, cormorants, and alcids (the family that includes murres, auks, auklets, and puffins) feed on the bottom at depths greater than 100 feet (ft.) (Cook et al., 2011; Ehrlich et al., 1988). Some seabirds are aerial plunge-divers in which they dive from above the surface and make generally shallow dives into the water column after prey (e.g., terns, gannets). Others are considered surface divers where they plunge directly from the surface underwater after prey (e.g., puffins, loons). Most diving species tend to catch the majority of their prey near the surface of the water column or on the bottom in shallow water (e.g., clams, mussels, and other invertebrates) (Cook et al., 2011). Dive durations are correlated with depth and range from a few seconds in shallow divers to several minutes in alcids (Ponganis, 2015). Petrels forage both night and day; they capture prey by resting on the water surface and dipping their bill and by aerial pursuit of flying fish (International Union for Conservation of Nature and Natural Resources, 2010b). More specific diving information in regard to species and taxonomic groups is provided in Sections 3.9.2.2.1 (Bermuda Petrel [*Pterodroma cahow*]) through 3.9.2.3.1.11 (Neotropical Migrant Songbirds, Thrushes, Allies, Cuckoos, Swifts, and Owls [Orders Passeriformes, Cuculiformes, and Apodiformes]).

While no bat species will dive into water, one bat species (the Mexican bulldog bat, or fishing bat [*Noctilio leporinus*]) primarily eats fish caught with its relatively large feet and long, sharp claws near the water's surface. Though this species does occur in Mexico, Puerto Rico, and the the U.S. Virgin Islands, it would be an infrequent visitor to the Study Area. (Jones et al., 1973; Placer, 1998). In a study of bat occurrence over water in the seas around Scandinavia, Ahlén et al. (2009) reported that both migrant and resident bats foraged over the sea in areas with an abundance of insects in the air and crustaceans in the surface waters. While it is expected that bats forage in a similar manner in the Study Area, it is also expected that such occurrence is infrequent and seasonal for the reasons described in Section 3.9.2.1 (General Background), above.

3.9.2.1.4 Hearing and Vocalization

Birds

Although hearing range and sensitivity has been measured for many land birds, little is known of seabird hearing. The majority of the published literature on bird hearing focuses on terrestrial birds and their ability to hear in air. A review of 32 terrestrial and marine species indicates that birds generally have greatest hearing sensitivity between 1 and 4 kilohertz (kHz) (Beason, 2004; Dooling, 2002). Very few can hear below 20 hertz (Hz), most have an upper frequency hearing limit of 10 kHz, and none exhibit hearing at frequencies higher than 15 kHz (Dooling, 2002; Dooling & Popper, 2000). Hearing capabilities have been studied for only a few seabirds (Beason, 2004; Beuter et al., 1986; Crowell et al., 2015; Johansen et al., 2016; Thiessen, 1958; Wever et al., 1969); these studies show that seabird hearing ranges and sensitivity in air are consistent with what is known about bird hearing in general.

Auditory abilities have been measured in ten diving bird species in-air using electrophysiological techniques (Crowell et al., 2015). All species tested had the best hearing sensitivity from 1 to 3 kHz. The red-throated loon (*Gavia stellata*) and northern gannet (*Morus bassanus*) (both non-duck species) had the highest thresholds of the diving birds while the lesser scaup (Aythya affinis) and ruddy duck (Oxyura jamaicensis) (both duck species) had the lowest thresholds (Crowell et al., 2015). Auditory sensitivity varied amongst the species tested, spanning over 30 dB in the frequency range of best hearing. While electrophysiological techniques provide insight into hearing abilities, auditory sensitivity is more accurately obtained using behavioral techniques. Crowell (2016) used behavioral methods to obtain an in-air audiogram of the lesser scaup. Best hearing frequency range in air was similar to other birds, with best sensitivity of 14 dB re 20 µPa at 2.86 kHz. Maxwell et al. (2017) obtained the behavioral in-air audiogram of a great cormorant (*Phalacrocorax carbo*) and the most sensitive hearing was 18 dB re 20 µPa at 2 kHz.

Crowell et al. (2015) also compared the vocalizations of the same ten diving bird species to the region of highest sensitivity of in-air hearing. Of the birds studied, vocalizations of only eight species were obtained due to the relatively silent nature of two of the species. The peak frequency of the vocalizations of seven of the eight species fell within the range of highest sensitivity of in-air hearing. Crowell et al. (2015) suggested that the colonial nesters tested had relatively reduced hearing sensitivity because they relied on individually distinctive vocalizations over short ranges. Additionally, Crowell et al.

(2015) observed that the species with more sensitive hearing were those associated with freshwater habitats, which are quieter compared to marine habitats with wind and wave noise.

Although important to seabirds in air, it is unknown if seabirds use hearing or vocalizations underwater for foraging, communication, predator avoidance or navigation (Crowell, 2016; Dooling & Therrien, 2012). Some scientists suggest that birds must rely on vision rather than hearing while underwater (Hetherington, 2008), while others suggest birds must rely on an alternative sense in order to coordinate cooperative foraging and foraging in low light conditions (e.g., night, depth) (Dooling & Therrien, 2012).

There is little known about the hearing abilities of birds underwater (Dooling & Therrien, 2012). In air, the size of the bird is usually correlated with the sensitivity to sound (Johansen et al., 2016); for example, songbirds tend to be more sensitive to higher frequencies and larger non-songbirds tend to be more sensitive to lower frequencies (Dooling & Popper, 2000). Two studies have tested the ability of a single diving bird, a great cormorant (*Phalacrocorax carbo sinensis*), to respond to underwater sounds (Hansen et al., 2017; Johansen et al., 2016). These studies suggests that the cormorant's hearing in air is less sensitive than birds of similar size; and the hearing capabilities in water are better than what would be expected for a purely in-air adapted ear (Johansen et al., 2016). The frequency range of best hearing underwater was observed to be narrower than the frequency range of best hearing in air, with greatest sensitivity underwater observed around 2 kHz (about 71 dB re 1 µPa based on behavioral responses) (Hansen et al., 2017). Although results were not sufficient to be used to generate an audiogram, Therrien (2014) also examined underwater hearing sensitivity of long-tailed ducks (*Clangula hyemalis*) by examining behavioral responses. The research showed that auditory thresholds at frequencies within the expected range of best sensitivity (1, 2, and 2.86 kHz) are expected to be between 77 and 127 dB re 1 µPa.

Diving birds may not hear as well underwater, compared to other (non-avian) species, based on adaptations to protect their ears from pressure changes (Dooling & Therrien, 2012). Because reproduction and communication with conspecifics occurs in air, adaptations for diving may have evolved to protect in-air hearing ability and may contribute to reduced sensitivity underwater (Hetherington, 2008). There are many anatomical adaptations in diving birds that may reduce sensitivity both in air and underwater. Anatomical ear adaptations are not well investigated, but include cavernous tissue in the meatus and middle ear that may fill with blood during dives to compensate for increased pressure on the tympanum, active muscular control of the meatus to prevent water entering the ear, and interlocking feathers to create a waterproof outer covering (Crowell et al., 2015; Rijke, 1970; Sade et al., 2008). The northern gannet, a plunge diver, has unique adaptations to hitting the water at high speeds, including additional air spaces in the head and neck to cushion the impact and a thicker tympanic membrane than similar sized birds (Crowell et al., 2015). All these adaptions could explain the measured higher thresholds of diving birds.

Bats

The hearing range of insect-eating bats in North America is 10 – 100 kHz. The most sensitive frequency band is 20 – 50 kHz, where bats can detect sounds at approximately 20 dB re 20 µPa (Bohn et al., 2006; Koay et al., 1997)Bats are generally unable to hear frequencies below 500 Hz. While hearing is the primary sense used by echolocating bats to forage and avoid obstacles, they use a combination of auditory and visual landmark recognition (Denzinger & Schnitzler, 2013; Gonzalez-Terrazas et al., 2016; Jensen et al., 2005; Schnitzler et al., 2003), magneto-reception (Holland et al., 2006; Holland et al., 2008; Wang et al., 2007), and spatial memory for long-distance navigation (Barchi et al., 2013; Ulanovsky & Moss, 2008, 2011; William & Williams, 1970; Williams et al., 1966).

The variety of vocalizations produced by bats can be separated into two general categories: ultrasonic echolocation sounds and communication sounds. Echolocation is used while foraging, in which bats listen for received echoes from insect targets. Sound detection levels are somewhat dependent on ambient noise, and bats increase the loudness of their calls when they encounter noise (Hage et al., 2013; Hotchkin & Parks, 2013; Luo & Wiegrebe, 2016). Echolocating bats have also been shown to passively listen for prey-generated sounds in the 2 – 14 kHz range when foraging (Kalko & Schnitzler, 1998; Razak et al., 1999). Call frequency and duration varies with habitat, food source, and social situation. Ultrasonic echolocation sound types vary by species (Denzinger & Schnitzler, 2013; Siemers & Schnitzler, 2004), and the duration of each call can range from 0.5 – 20 ms (Ulanovsky & Moss, 2008). Outgoing echolocation beams produced by bats are directional and are analogous to a searchlight in that it illuminates or 'ensonifies' objects when it is aimed at them (Moss et al., 2011). Insect targets can be identified from a maximum range of approximately 25 m using echoes in the 25 – 30 kHz frequency spectra (Stilz & Schnitzler, 2012). The big brown bat (*E. fuscus*) is the most-studied North American bat species and is a good representative insect-eating species that produces different types of echolocation calls depending on whether it is hunting in a dense forest or an open space (Moss et al., 2011). This species produces broadband ultrasonic echolocation sounds in the 22 – 105 kHz range.

Communication sounds produced by bats are typically lower in frequency than echolocation calls, although some bats use ultrasonic vocalizations for communication (Smotherman et al., 2016). Echolocation sounds may also contain socially relevant information (Kazial & Masters, 2004; Masters et al., 1995). Vocal communication in bats is restricted to short ranges because high-frequency sounds dampen very quickly in air. However, research suggests that hoary bats (*Lasiurus cinereus*) and silver-haired bats (*Lasionycteris noctivagans*) are not likely to socially communicate on migration routes (Baerwald & Barclay, 2016).

3.9.2.1.5 General Threats

Approximately half of the 346 species of seabirds that depend on ocean habitats are declining (Crowell et al., 2015). Seabirds are some of the most threatened marine animals in the world, with 29 percent of species at risk of extinction (Spatz et al., 2014). Threats to bird populations in the Study Area include human-caused stressors (including incidental mortality) from interactions with commercial and recreational fishing gear, predation and competition by introduced species, disturbance and degradation of nesting areas by humans and domesticated animals, noise pollution from construction and other human activities, nocturnal collisions with power lines and artificial lights, collisions with aircraft, and pollution, such as that from oil spills and plastic debris (Anderson et al., 2007; Burkett et al., 2003; California Department of Fish and Game, 2010; Carter & Kuletz, 1995; Carter et al., 2005; Clavero et al., 2009; International Union for Conservation of Nature and Natural Resources, 2010b; North American Bird Conservation Initiative & U.S. Committee, 2010; Onley & Scofield, 2007; Piatt & Naslund, 1995; U.S. Fish and Wildlife Service, 2005, 2008b; Waugh et al., 2012; Weimerskirch, 2004). Disease, volcanic eruptions, storms, and harmful algal blooms are also threats to birds (Anderson et al., 2007; Jessup et al., 2009; North American Bird Conservation Initiative U.S. Committee, 2009; U.S. Fish and Wildlife Service, 2005).

Beach-nesting birds are vulnerable to disturbance from people, pets, and off road vehicles that may inadvertently destroy or disturb nests (North American Bird Conservation Initiative U.S. Committee, 2009). Feral species (primarily cats [*Felis catus*] and rats [*Rattus* spp.], occasionally pigs [*Sus scrofa*], and cattle [*Bos taurus*]) may destroy nesting colonies. Seabirds are especially vulnerable to feral species on islands where nests and populations have been devastated through predation or habitat destruction.

Invasive plants can also eliminate nesting habitat on beaches (Clavero et al., 2009; North American Bird Conservation Initiative U.S. Committee, 2009).

Lighting on boats and on offshore oil and gas platforms has also contributed to bird fatalities in open ocean environments when birds are attracted to these lights, usually in inclement weather conditions (Merkel & Johansen, 2011). Recent studies have looked at different lighting systems and how they may impact migrating songbirds (Poot et al., 2008). Land-based lighting has been linked to episodes of "fallout" (grounding) involving seabirds, especially petrels, and ship-based lighting could have similar effects (Rodríguez et al., 2017).

Large-scale wind energy development in offshore areas has the potential to affect bird populations through 1) displacement from favored foraging habitats, especially to species that forage in deeper, offshore waters; and 2) mortality to species that tend to fly within the rotor swept zones of large wind turbines (approximately 20 m and 200 m from the surface) (Williams et al., 2015).

Natural causes of seabird and shorebird population declines include disease, storms, and harmful algal blooms, although human activities are also associated with harmful algal blooms (Jessup et al., 2009; North American Bird Conservation Initiative U.S. Committee, 2009; Onley & Scofield, 2007). In addition, seabird distribution, abundance, breeding, and other behaviors are influenced by cyclical environmental events, such as the El Niño Southern Oscillation and Pacific Decadal Oscillation in the Pacific Ocean (Congdon et al., 2007; Vandenbosch, 2000).

The primary threats to bats include disease (discussed in Section 3.9.2.1.5.3, Disease and Parasites), climate change (discussed in Section 3.9.2.1.5.5, Climate Change), commercial industries, especially wind energy development (discussed in Section 3.9.2.1.5.2, Commercial Industries), and habitat loss and fragmentation.

3.9.2.1.5.1 Water Quality

Spills of oil and other petroleum products pose a risk to seabirds and shorebirds through direct contamination and destruction of nesting, roosting, and foraging habitats (U.S. Environmental Protection Agency, 1999). Estimates of bird mortality caused by the BP *Deepwater Horizon* oil spill in the Gulf of Mexico during 2010 are that approximately 200,000 birds were killed in the offshore area and approximately 700,000 killed along the coastline during the 103-day duration of the spill (Haney et al., 2014a, 2014b). Additional mortality occurred subsequently but has not been estimated.

3.9.2.1.5.2 Commercial Industries

A recent review of reported bycatch estimates suggests that at least 400,000 birds die in gillnets each year (Zydelis et al., 2013). Commercial fisheries are considered the most serious threat to the world's seabirds, while invasive species are the most pervasive – affecting the largest number of species; other threats include pollution, hunting, trapping, energy production, and mining (BirdLife International, 2012).

Large-scale offshore wind development may occur in highly productive areas of the Atlantic Seaboard and impact bird populations 1) by displacing some species from their preferred foraging habitats and migration routes; 2) increasing the mortality of species that fly within the rotor-swept zones of large turbines individuals (Williams et al., 2015).

Wind turbines may attract bats directly (e.g., there is evidence that bats perceive smooth wind turbine surfaces to be water) (McAlexander, 2013) or indirectly (e.g., by attracting insects) (Pelletier et al., 2013), where they may be injured or killed by collision with a wind turbine's blade or by barotrauma (a sudden drop in pressure that a bat encounters when flying near the rotating blade). Bats are also known to roost on wind turbines, including offshore wind turbines (Ahlén et al., 2009).

3.9.2.1.5.3 Disease and Parasites

Avian diseases can cause chronic population declines, dramatic die-offs or reductions in the reproductive success and survival of individual birds. They can even cause extinctions. Certain avian diseases appear to be spreading to populations previously unaffected, including to species already threatened by other factors. Examples include avian botulism, cholera, *Erysipelothrix rhusiopathiae*, West Nile virus and Mycoplasmal conjunctivitis. A brief description of each follows.

Avian botulism is a bacterial disease that is arguably the most important disease of migratory birds world-wide, affecting millions of birds. Avian cholera and (*Erysipelothrix rhusiopathidae*) are two bacterial diseases that caused considerable declines of Indian yellow-nosed albatross (*Thalassarche carteri*) on Amsterdam Island (French Southern Territories). These two diseases may have spread to nearby colonies of sooty albatross (*Phoebetria fusca*) and Amsterdam albatross (*Diomedea amsterdamensis*) with a world population of approximately 130 birds. Avian cholera has also devastated the population of Cape cormorant (*Phalacrocorax capensis*) in Western Cape Province, South Africa, killing approximately 13,000 individuals between May and October 2002. The West Nile Virus, a largely mosquito-borne viral disease (causing both bird and human mortalities), has established itself over much of eastern United States since 1999, spreading to Latin America and the Caribbean. American crow (*Corvus brachyrhynchos*) and other corvid species have shown very high levels of mortality from this disease but remains relatively stable across its range. Mycoplasmal conjunctivitis, as the disease is commonly called, is caused by a unique strain of (*Mycoplasmal gallisepticum*), a parasitic bacterium previously known to infect only poultry. This infectious disease has recently caused a significant decline in the introduced population of house finch (*Carpodacus mexicanus*) in eastern North America, and has started to spread to the native population of this species in western North America (BirdLife International, 2008c).

White-nose syndrome, caused by a white fungus, (*Pseudogymnoascus destructans*) was first discovered in North America in a cave in New York in 2006. Since then, the disease has spread to seven bat species in 32 states and 5 Canadian provinces. The disease has killed at least 5.7 million bats, caused precipitous declines in populations of cave-hibernating bat species in the northeast region, and led to the federal listing of the northern long-eared bat as threatened under the ESA. From its original detection in New York, the disease has spread widely throughout the New England states and the interior of the eastern United States (U.S. Geological Survey, 2018). On average, 96 percent of new white-nose syndrome counties in any single year were within 150 miles of a county that was fungus or white-nose syndrome-positive during the prior year. The fungus is generally present for a year or two before symptoms of white-nose syndrome appear and mortality of bats begins to occur (U.S. Fish and Wildlife Service, 2016a). It is thought that half of America's bats are at risk to the disease (Bat Conservation International, 2017). The most common bats affected by white-nose syndrome are little brown bats, followed by the federally threatened northern long-eared bats and the federally endangered Indiana bat (*Myotis sodalis*). Some small-footed bats (*Myotis leibii*), tri-colored bats (*Perimyotis subflavus*) and big brown bats have also been affected (Yates, 2015).

Surveys at several sites in the Gulf of Maine from 2009-2014 detected a decline in the amount of *Myotis* species relative to that of other species, primarily in 2012 and 2013. At one site, overall activity levels declined from 294 passes per night (with activity during 97% of nights) in 2012 to 6.4 passes per night (with activity during 37% of nights) in 2014 (U.S. Department of Energy, 2016).

The little brown bat has had one of the highest mortality rates from white-nose syndrome and is estimated to have had a population decrease of 91 percent in the east. Big brown bats are less affected by white-nose syndrome and red bats, hoary bats, and silver-haired bats are migrators rather than hibernators, which allow them to avoid hibernacula that harbor this fungus (Hayman et al., 2016; Tetra Tech Inc, 2016a).

3.9.2.1.5.4 Invasive Species

Significant threats to seabirds occur on islands, which is where seabirds breed, including predation and habitat disturbance from invasive alien species such as rats, cats and pigs. Ground-nesting seabirds are particularly vulnerable to these threats, and invasive predators on islands have been the primary cause of global seabird declines, extirpations, and local extinctions (Spatz et al., 2014). However, in many cases, effective island conservation can mitigate these threats.

3.9.2.1.5.5 Climate Change

In the long term, global climate change could be the greatest threat to seabirds (North American Bird Conservation Initiative & U.S. Committee, 2010). Climate change impacts include changes in air and sea temperatures, precipitation, the frequency and intensity of storms, pH level of sea water, and sea level. These changes could impact the timing of migration and overall marine productivity, which could in turn have an impact on the food resources, distribution, and reproductive success of seabirds at critical times in their life cycles (Aebischer et al., 1990; Congdon et al., 2007; Davoren et al., 2012).

Open ocean seabird species are particularly vulnerable to climate change due to their low reproductive rates, their use of islands for nesting, and their reliance on a highly variable marine system (North American Bird Conservation Initiative & U.S. Committee, 2010). Coastal birds are vulnerable to climate change due to rising sea levels, which are expected to impact foraging and nesting habitat quality and quantity by flooding or fragmenting habitats such as barrier islands, beaches, and mudflats (North American Bird Conservation Initiative & U.S. Committee, 2010).

Climate change could impact bats at all stages in their annual cycle. U.S. Fish and Wildlife Service (2016a), for example, writes:

> "The unique life history traits of bats and their susceptibility to local temperature, humidity, and precipitation patterns make them an early warning system for effects of climate change in regional ecosystems. Climate influences food availability, timing of hibernation, frequency and duration of torpor, rate of energy expenditure, reproduction, and rates of juvenile bat development. Climate change may lead to warmer winters, which could lead to a shorter hibernation period, increased winter activity, and reduced reliance on the relatively stable temperatures of underground hibernation sites. An earlier spring would presumably result in a shorter hibernation period and the earlier appearance of foraging bats. An earlier emergence from hibernation may have no detrimental effect on populations if sufficient food is available; however, predicting future insect population dynamics and distributions is complex. Alterations in precipitation, stream flow, and soil moisture could alter insect populations and, therefore, food availability for bats."

Additionally, altered seasonal ambient temperatures and precipitation patterns could also shift the range of some species and alter water and roost availability (U.S. Fish and Wildlife Service, 2016a), and extreme weather events have led to large die-offs (Mistry & Moreno-Valdez, 2008). Bat populations are particularly susceptible to such large die-offs due to their low reproductive rates (Bogan, 2016). Climate change will also change prey detection ability of echolocating bats, with some species gaining a greater ability to detect prey and others having a reduced ability to detect prey species (Luo et al., 2013).

3.9.2.1.5.6 Marine Debris

Marine debris is any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment or the Great Lakes (National Oceanic and Atmospheric Administration, 2016). Marine debris is a growing environmental concern. With the rapid increase in global plastics production and the resulting large volume of litter that enters the marine environment, determining the consequences of this debris on marine fauna, including seabirds and ocean health has now become a critical environmental priority, particularly for threatened and endangered species (Wilcox et al., 2016).

Plastic debris is abundant and pervasive in the world oceans and, because of its durability, is continuing to increase. The ingestion of plastics by seabirds such as albatrosses and shearwaters occurs with high frequency and is of particular concern because of impacts on body condition and the transmission of toxic chemicals, both of which affect mortality and reproduction. The rates of plastic ingestion by seabirds are closely related to the concentrations of plastics in different areas of the ocean due to waste discharges and ocean currents, and are increasing (Kain et al., 2016; Wilcox et al., 2015).

The impacts from entanglement of marine species in marine debris are clearly profound, and in many cases entanglements appear to be increasing despite efforts over four decades to reduce the threat. Many coastal states have undertaken certain efforts to reduce entanglement rates through marine debris clean-up measures and installed fishing line recycle centers at boat landings in part due to entanglement of seabirds and other marine species.

Fishing related gear, balloons and plastic bags were estimated to pose the greatest entanglement risk to marine fauna. In contrast, experts identified a broader suite of items of concern for ingestion, with plastic bags and plastic utensils ranked as the greatest threats. Entanglement and ingestion affected a similar range of taxa, although entanglement was rated as slightly worse because it is more likely to be lethal. Contamination was scored the lowest in terms of impact, affecting a smaller portion of the taxa and being rated as having solely non-lethal impacts (Wilcox et al., 2016).

There are likely other species from other regions of the U.S. that suffer injury or death from being entangled in marine debris, but are not widely recognized or reported. Most of the literature describes entanglement of marine species from Alaska, California, Puget Sound, and Florida. However, the Mid-Atlantic and Gulf of Mexico regions of the U.S. are lacking in reports of marine debris entanglement. Similarly, reports of marine debris entanglement on seabirds are limited to a few papers (National Oceanic and Atmospheric Administration, 2016). This review reported entanglement in marine debris in the U.S. of 44 species of seabirds. The majority of cases revolve around entanglement in abandoned, lost or otherwise discarded fishing gear and to a lesser degree other plastic debris.

More general information about marine debris along the southeast Atlantic coast concluded the vast majority of marine debris was either land-based (38 percent), general-source debris (42 percent), or ocean-based (20 percent) recreational and commercial sources (Ribic et al., 2010); no items of military origin were differentiated.

3.9.2.2 Endangered Species Act-Listed Species

There are four species of birds and two species of bats listed as endangered or threatened under the ESA that occur in the Study Area (U.S. Fish and Wildlife Service, 2015a). One ESA-listed species, the piping plover (*Charadrius melodus*), has critical habitat that is described in greater detail in Section 3.9.2.2.2.1 (Status and Management). The status, presence, and occurrence of ESA-listed bird and bat species in the Study Area are discussed further below.

Table 3.9-1: Endangered Species Act-List Bird and Bat Species in the Study Area

Species Name and Regulatory Status			*Presence in the Study Area*[1]		
Common Name	*Scientific Name*	*ESA Status*	*Open Ocean Area*	*Large Marine Ecosystem*	*Inshore Waters*
Bermuda Petrel	*Pterodroma cahow*	Endangered	North Atlantic Gyre (nesting), Gulf Stream	Newfoundland-Labrador Shelf, Scotian Shelf, Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf	None
Roseate Tern[2]	*Sterna dougallii dougallii*	Endangered Threatened	North Atlantic Gyre, Gulf Stream	Scotian Shelf (nesting), Northeast U.S. Continental Shelf (nesting), Southeast U.S. Continental Shelf, Gulf of Mexico (nesting), Caribbean Sea (nesting)	Sandy Hook Bay (Earle, NJ); Lower Chesapeake Bay (Hampton Roads, VA); Beaufort Inlet Channel (Morehead City, NC); Cape Fear River (Wilmington, NC); St. Andrew Bay (Panama City, FL); Sabine Lake (Beaumont, TX); Corpus Christi Bay (Corpus Christi, TX)
Piping Plover	*Charadrius melodus*	Threatened	None	Newfoundland-Labrador Shelf, Scotian Shelf, Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Gulf of Mexico, Caribbean Sea	Sandy Hook Bay (Earle, NJ); Lower Chesapeake Bay (Hampton Roads, VA); Beaufort Inlet Channel (Morehead City, NC); Cape Fear River (Wilmington, NC); St. Mary's River Inlet (St. Mary's, GA); St. Johns River and Fort George River Inlets (Jacksonville, FL); St. Andrew Bay (Panama City, FL); Sabine Lake (Beaumont, TX); Corpus Christi Bay (Corpus Christi, TX)
Red Knot	*Calidris canutus rufa*	Threatened	North Atlantic Gyre, Gulf Stream	Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Gulf of Mexico, Caribbean Sea	Sandy Hook Bay (Earle, NJ); Lower Chesapeake Bay (Hampton Roads, VA); Beaufort Inlet Channel (Morehead City, NC); Cape Fear River (Wilmington, NC); St. Andrew Bay (Panama City, FL); Sabine Lake (Beaumont, TX); Corpus Christi Bay (Corpus Christi, TX)

Table 3.9-1: Endangered Species Act-List Bird and Bat Species in the Study Area (continued)

Species Name and Regulatory Status			*Presence in the Study Area*[1]		
Common Name	***Scientific Name***	***ESA Status***	***Open Ocean Area***	***Large Marine Ecosystem***	***Inshore Waters***
Indiana bat	*Myotis sodalis*	Endangered	None	Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf	Sandy Hook Bay (Earle, NJ); Lower Chesapeake Bay (Hampton Roads, VA)
Northern long-eared bat	*Myotis septentrionalis*	Threatened	None	Scotian Shelf (roosting), Northeast U.S. Continental Shelf (roosting), Southeast U.S. Continental Shelf	Sandy Hook Bay (Earle, NJ); Lower Chesapeake Bay (Hampton Roads, VA); Cape Fear River (Wilmington, NC)

[1]Presence in the Study Area indicates open ocean areas (North Atlantic Gyre, Gulf Stream, and Labrador Current) and coastal waters of large marine ecosystems (West Greenland Shelf, Newfoundland-Labrador Shelf, Scotian Shelf, Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Gulf of Mexico, and Caribbean Sea) in which the species are found. Open ocean areas and coastal waters where breeding occurs are indicated as (nesting).

[2]The roseate tern is listed as endangered under the ESA along the Atlantic coast south to North Carolina, Canada (Newfoundland, Nova Scotia, Quebec), and Bermuda. It is listed as threatened under the ESA in the Western Hemisphere and adjacent oceans, including Florida, Puerto Rico, and the Virgin Islands.

Source**:** (U.S. Fish and Wildlife Service, 2015a), for ESA Status.

Note**:** The abbreviations in the table are defined as follows—DE: Delaware; FL: Florida; GA: Georgia; NC: North Carolina; NJ: New Jersey; TX: Texas; VA: Virginia; ESA: Endangered Species Act, Gulf of Mexico: Gulf of Mexico.

The federally endangered Florida bonneted bat (*Eumops floridanus*) occurs in southern Florida and is thought to be the rarest bat in the world (Florida Fish and Wildlife Conservation Commission, 2017b). However, it is not expected to occur in the Study Area as it primarily forages over freshwater ponds, streams, and wetlands (U.S. Fish and Wildlife Service, 2013a). The nearest occurrence of the federally endangered gray bat (*Myotis grisescens*) to the Study Area is one county in Florida's panhandle that is adjacent to Alabama and Georgia and is also not expected to occur in the Study Area (Florida Fish and Wildlife Conservation Commission, 2017c). The Mexican Long-nosed bat (*Leptonycteris nivalis*) and the lesser long-nosed bat (*Leptonycteris curasoae*) migrate through Central Mexico (from the Pacific Coast to Gulf of Mexico) to the southwest U.S. (International Union for Conservation of Nature, 2017; National Park Service, 2017b). Therefore, some individuals may migrate over the western-most portions of the Gulf of Mexico but the chances they would interact with Navy training activities is discountable. As such, these four species will not be discussed further.

3.9.2.2.1 Bermuda Petrel (*Pterodroma cahow*)

3.9.2.2.1.1 Status and Management

The USFWS listed the Bermuda petrel as endangered under the ESA in 1970. There is no designated critical habitat for this seabird species. This extremely rare seabird nests only on Bermuda in the Atlantic Ocean (White, 2004). The Bermuda petrel was thought to be extinct for about three decades until its existence was confirmed in the mid-1900s. In 1951, 18 pairs of the Bermuda petrel (commonly referred to as "cahow") were rediscovered breeding on a group of four rocky islets in Castle Harbor, Bermuda. An intensive recovery and management program followed, which included removing predators, such as rats (Murphy & Mowbray, 1951), and adapting nest burrow entrances with baffles and artificial burrows to prevent nest site competition with the white-tailed tropicbird (*Phaethon lepturus*) (Murphy & Mowbray, 1951). Efforts to establish a new breeding colony in the higher areas of Nonsuch Island Nature Reserve have been slow but promising (Dobson & Madeiros, 2009). The total population is estimated as approximately 250-275 individuals with 71 breeding pairs in 2005, 96 breeding pairs in 2009 (Dobson & Madeiros, 2009), and 101 breeding pairs in 2012 (U.S. Fish and Wildlife Service, 2013c).

3.9.2.2.1.2 Habitat and Geographic Range

The Bermuda petrel is a pelagic species and spends most of its life at sea, except during the breeding season from January to June where it comes ashore to breed. Breeding occurs outside the Study Area, exclusively in Bermuda on five small islets off Nonsuch Island in the North Atlantic Gyre (National Audubon Society, 2005). Available islet nesting habitat is limited to 2.4 acres (ac) (0.97 hectares [ha]), which is occupied by a varying number of breeding pairs each year (BirdLife International, 2008a). During the breeding season, the Bermuda petrel arrives and leaves the island only at night to avoid predation (Wurster & Wingate, 1968). During the breeding season, the Bermuda petrel nests in colonies, but is otherwise solitary (Onley & Scofield, 2007). Due to its solitary behavior the Bermuda petrel is unlikely to approach ships (Enticott & Tipling, 1997; Onley & Scofield, 2007). More specific nest density or colony size information was not found.

Open Ocean Areas. In the nonbreeding season (June–December) (Brooke, 2004), the species migrates from the breeding grounds in Bermuda to foraging routes over much of the Atlantic Ocean, including waters of the North Atlantic Gyre and the Gulf Stream (includes off-shelf portions of the Virginia Capes and Navy Cherry Point Range Complexes) (Lee & Mackin, 2008; National Audubon Society, 2005; Onley & Scofield, 2007). However, dispersal and at-sea distribution are generally poorly known (Brooke, 2004; Onley & Scofield, 2007). One additional migration route was recorded into the northeast Atlantic, off the coast of southwestern Ireland (Dobson & Madeiros, 2009).

Southeast U.S. Continental Shelf Large Marine Ecosystem. First reported off North Carolina's Outer Banks in April 1983 (Lee, 1987), today the species regularly occurs off the North Carolina coast (National Audubon Society, 2005; White, 2004).

Newfoundland-Labrador Shelf, Scotian Shelf, and Northeast U.S. Continental Shelf Large Marine Ecosystems. Recent data recorded during the nonbreeding season documented western routes to the Gulf Stream and northern movements to the Bay of Fundy, into the Gulf of St. Lawrence, and over the Grand Banks. An additional route was recorded off the coast of southwestern Ireland (Madeiros, 2009).

3.9.2.2.1.3 Population Trends

The Bermuda petrel is an extremely rare seabird that is slowly but steadily increasing: 18 pairs were recorded in the year 1951; 70 pairs raising 40 young were recorded in 2003; 71 pairs raising 35 young were recorded in 2005 (International Union for Conservation of Nature and Natural Resources, 2010a). The reproductive output between 2000 to 2001 and 2007 to 2008 ranged from 29 to 40 fledglings per year (Madeiros et al., 2012). Conservation efforts continue and the species is recovering in number, with the population estimated at 250-275, with 101 breeding pairs as of 2012 (U.S. Fish and Wildlife Service, 2013c). The number of chicks successfully fledged per nesting season has also increased, reaching 52 in 2010 (Dobson, 2010) and 57 in 2012 (U.S. Fish and Wildlife Service, 2013c).

3.9.2.2.1.4 Predator and Prey Interactions

Bermuda petrels feed mostly on squid, but their diet also consists of shrimp and small fish (National Audubon Society, 2005). Specific information on the feeding behavior of Bermuda petrels is lacking, but petrels of the genus *Pterodroma* often land on the ocean surface where they scavenge or grab prey;

they also feed on the wing (while flying), where they are able to catch flying fish (Onley & Scofield, 2007).

Maximum dive depths for several species of *Pterodroma* petrels in New Zealand were determined from depth gauges that were attached to individual birds and recovered after varying lengths of time during which the birds were foraging at sea (Taylor, 2008). Mean maximum dive depths ranged from 1.1 to 4.7 m, with a maximum depth recorded of 23 meters. Maximum dive depths were similarly determined for the Providence petrel (*Pterodroma solandri*), an Australian species, and found to average 2.9 m (Bester et al., 2011). It is reasonable to conclude that in addition to feeding at the surface, petrels of the genus *Pterodroma,* (probably including the Bermuda petrel) frequently engage in surface plunging or pursuit diving to reach prey several meters below the surface. No data are available on submergence times, but to reach these depths presumably requires a petrel to be underwater for roughly 5-10 seconds.

3.9.2.2.1.5 Species-Specific Threats

Current threats to this species include habitat loss; competition for nest sites with the white-tailed tropicbird (Dobson & Madeiros, 2009); egg failure from contaminants (Brooke, 2004; Wurster & Wingate, 1968); light pollution from a nearby Bermuda airport; sea level rise; and increasing frequency and magnitude of tropical storms and hurricanes, which destroy nests through erosion, wave damage, and flooding (BirdLife International, 2008a, 2008b; Dobson & Madeiros, 2009; Madeiros et al., 2012; U.S. Fish and Wildlife Service, 2013c).

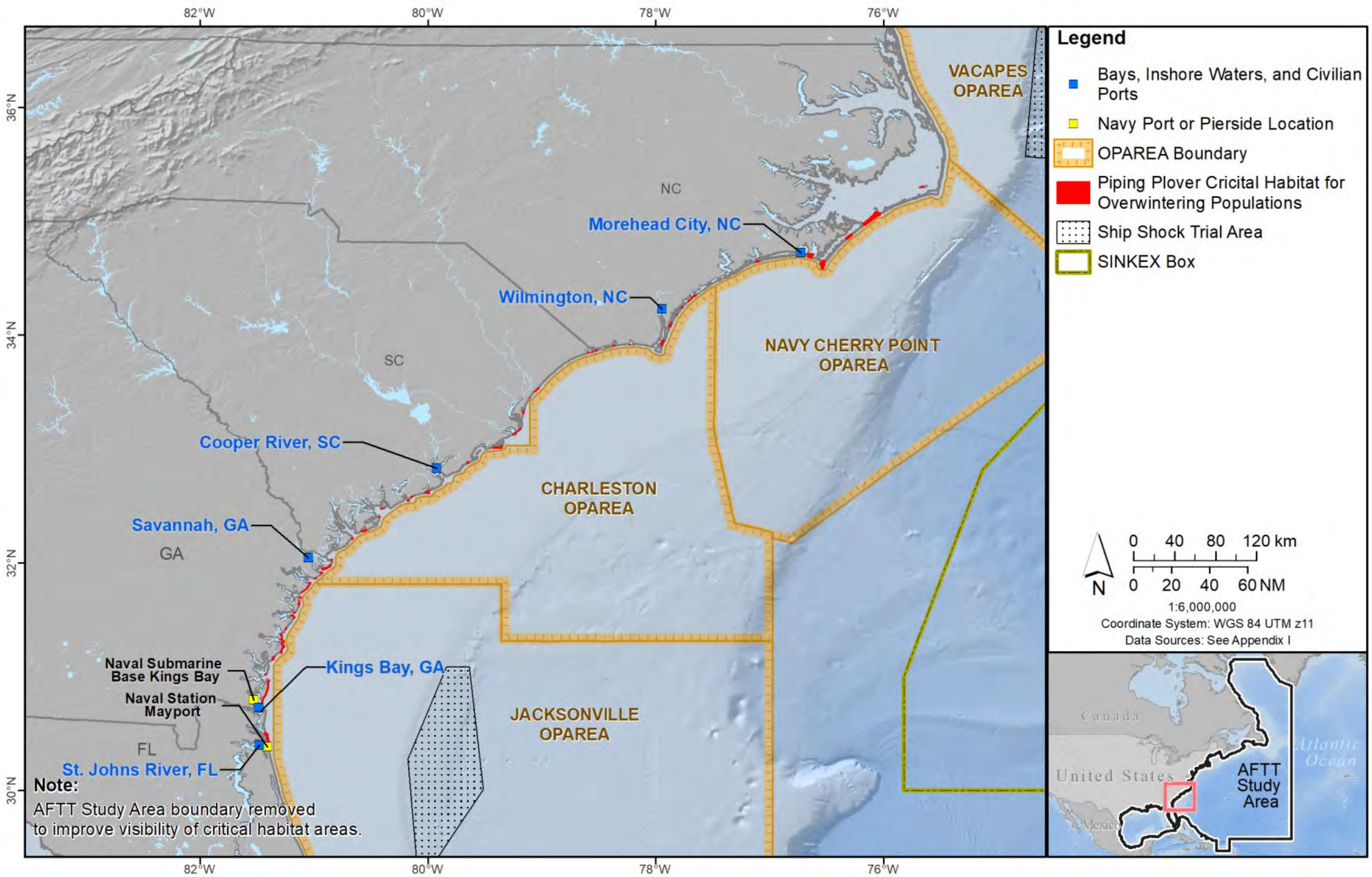
3.9.2.2.2 Piping Plover (*Charadrius melodus*)

The piping plover is divided into two subspecies of plovers. The piping plovers that breed on the Atlantic coast of the United States and Canada belong to the Atlantic subspecies *C. melodus* (U.S. Fish and Wildlife Service, 2009b) and occur within the Study Area.

3.9.2.2.2.1 Status and Management

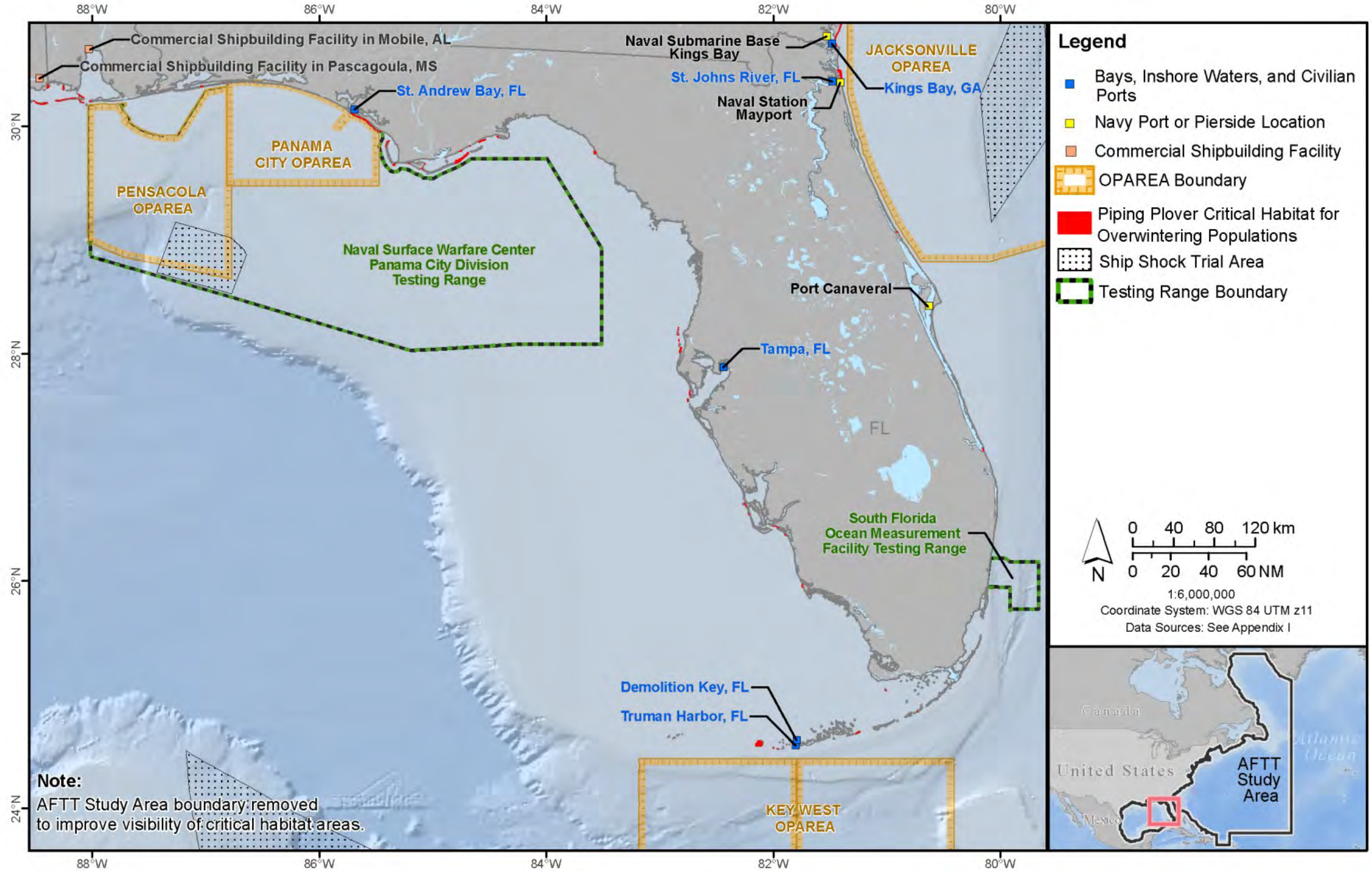
The USFWS listed the Atlantic coast piping plover population as threatened under the ESA in 1985 and has instituted a recovery plan for this shorebird species (U.S. Fish and Wildlife Service, 1996). In 2001 and 2002, critical habitat was designated for the Great Lakes breeding population and Northern Great Plains breeding population, and for all three breeding populations while on their wintering grounds. Critical habitat for wintering plovers has been designated in coastal areas near or within the Study Area as shown in Figure 3.9-1, Figure 3.9-2, and Figure 3.9-3.

The USFWS designated 137 areas along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas as critical habitat for wintering populations. This critical habitat includes 1,798.3 mi. (2,891.7 km) of mapped shoreline and 165,211 ac (66,881 ha) of mapped area along the gulf and Atlantic coasts and along interior bays, inlets, and lagoons (*Federal Register* 66[132]: 36038-36086, July 10, 2001). In 2008 and 2009, the USFWS updated designated critical habitat for wintering piping plover populations in North Carolina and Texas, adding 2,043 ac (827 ha) in North Carolina and 139,029 ac (56,263 ha) along the Gulf Coast of Texas (*Federal Register* 73[204]: 62816-62841, October 21, 2008; and *Federal Register* 74 [95]: 23476-23600, May 19, 2009, respectively). Any critical habitat located above the mean high tide line is outside the Study Area, as described in Section 3.0.2 (Ecological Characterization of the Study Area).



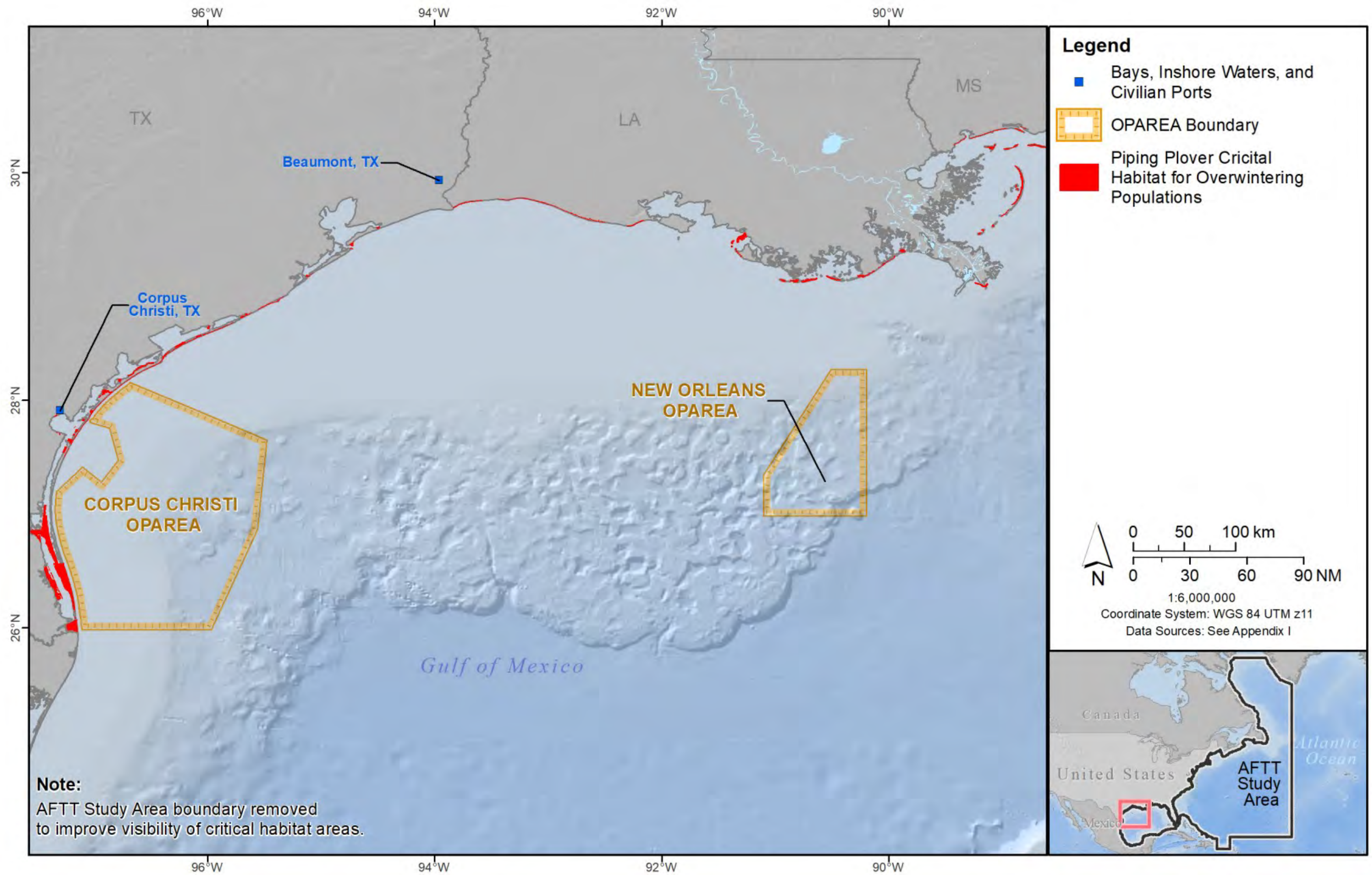
Notes: AFTT: Atlantic Fleet Training and Testing; OPAREA: operating area; SINKEX: ship sinking exercise; VACAPES: Virginia Capes.

Figure 3.9-1: Critical Habitat Areas for Piping Plover in and Adjacent to the Atlantic Coastal Portions of the Study Area



Notes: AFTT: Atlantic Fleet Training and Testing; OPAREA: operating area; SINKEX: ship sinking exercise.

Figure 3.9-2: Critical Habitat Areas for Piping Plover in and Adjacent to the Eastern Gulf of Mexico Coastal Portions of the Study Area



Notes: AFTT: Atlantic Fleet Training and Testing; OPAREA: operating area; SINKEX: ship sinking exercise.

Figure 3.9-3: Critical Habitat Areas for Piping Plover in and Adjacent to the Western Gulf of Mexico Coastal Portions of the Study Area

The 2004 National Defense Authorization Act allows military installations to be excluded from critical habitat designation for endangered species under the ESA provided that the installation's Integrated Natural Resource Management Plan affords (1) a benefit to the species; (2) certainty that the management plan will be implemented; and (3) certainty that the conservation effort will be effective. On Navy installations where piping plovers breed or overwinter, the Navy is exempt from critical habitat designations.

3.9.2.2.2.2 Habitat and Geographic Range

In the Study Area, the Atlantic breeding population of piping plovers nest and breed on coastal beaches from southern Maine to North Carolina and are primarily an inhabitant of sandy shorelines in the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems (Haig & Elliott-Smith, 2004; O'Brien et al., 2006). Piping plovers nest above the mean high tide line (outside the Study Area) on coastal beaches, sand flats at the ends of sandpits and barrier islands, gently sloping foredunes (dunes parallel to the shoreline), blowout areas behind primary dunes, and washover areas cut into or between dunes (U.S. Fish and Wildlife Service, 1996). Individuals migrate through and winter in coastal areas of the United States from North Carolina to Texas and portions of Yucatan in Mexico and the Caribbean (U.S. Fish and Wildlife Service, 2009b). Different breeding populations tend to occur in different coastal wintering areas, although there is some overlap (Gratto-Trevor et al., 2012). In winter, the species is only found in coastal areas in habitats that include mudflats and dredge spoil areas and, most commonly, sandflats (Gratto-Trevor et al., 2012; O'Brien et al., 2006). Plovers appear to prefer sandflats adjacent to inlets or passes, sandy mudflats along spits (beaches formed by currents), and overwash areas as foraging habitats. Piping plover migration routes overlap with breeding and wintering habitats.

Southeast U.S. Continental Shelf Large Marine Ecosystem. Recovery results from birds banded during the breeding season indicate that most Atlantic coast breeders winter along the southern Atlantic coast from North Carolina to Florida, although some birds have been reported to winter in Texas (Gratto-Trevor et al., 2012) Evidence suggests that most of the Great Lakes population winters south along the Atlantic coast. Both spring and fall migration routes are believed to follow the Atlantic coast (Gratto-Trevor et al., 2012).

Gulf of Mexico Large Marine Ecosystem. Evidence suggests that most of the threatened Northern Plains population winters on the Gulf Coast (Gratto-Trevor et al., 2012).

Caribbean Sea Large Marine Ecosystem. Islands in the Caribbean, the Bahamas and West Indies, serve as important wintering habitat (U.S. Geological Survey, 2007).

3.9.2.2.2.3 Population Trends

A 1991 international census documented 5,482 piping plovers and a decade later in 2001 the population estimate was 5,945 piping plovers (Haig & Elliott-Smith, 2004). The current population has been estimated to be approximately 8,100 individuals (BirdLife International, 2016). Coastal Atlantic United States populations have trended upward since listing, though some areas' breeding populations are remaining at depressed levels and showing little or no increase in size. Since its 1985 listing, the Atlantic coast population estimate has increased from 790 pairs to an estimated 1,849 pairs in 2008, and the United States portion of the population has almost tripled, from approximately 550 pairs to an estimated 1,596 pairs (U.S. Fish and Wildlife Service, 2009c). Between 1989 and 2008, the largest population increase occurred in New England (245 percent), followed by New York–New Jersey (74 percent). Overall population growth was tempered by rapid declines in the Southern and Eastern Canada recovery units; the eastern Canada population decreased 21 percent (2002–2005), and the population in the southern half of the Southern recovery unit declined 68 percent (1995–2001) (U.S. Fish and Wildlife Service, 2009c). Also, the Maine population declined 64 percent, from 66 pairs in the year 2002 to 24 pairs in 2008, mostly due to loss of habitat from spring storms and dune stabilization projects. More recently, numbers have declined, with 3,973 piping plovers observed during the winter census of the 2011 International Piping Plover Census, with Texas having by far the largest number of any state (2,145), and more than 1,000 piping plovers discovered wintering in the Bahamas (Elliott-Smith et al., 2015). The 2011 breeding census resulted in an estimated breeding population of at least 5,723 birds, 75 percent of which were in the United States, with a breeding population of 1,476 pairs in the Atlantic coastal states (Elliott-Smith et al., 2015). Though the abundance of the Atlantic coast plovers has reduced near-term extinction threats, geographic variation in population growth and sensitivity to survival and productivity are cause for continuing conservation concern (U.S. Fish and Wildlife Service, 2009c).

3.9.2.2.2.4 Predator and Prey Interactions

Feeding habitats of breeding piping plovers include intertidal portions of ocean beaches, washover areas, mudflats, sandflats, wrack lines (line of deposited seaweed on the beach), shorelines of coastal ponds, lagoons, and salt marshes (Gratto-Trevor et al., 2012; U.S. Fish and Wildlife Service, 1996). They hunt visually using a start-and-stop running method, gleaning and probing the substrate for a variety of small invertebrates (marine worms, crustaceans, molluscs, insects, and the eggs and larvae of many marine invertebrates) (Maslo et al., 2012; U.S. Fish and Wildlife Service, 1996). Foraging occurs throughout the day and at night.

Piping plovers are preyed upon by various species. These predators, such as crows, gulls, raptors, raccoons, foxes, skunks, and domestic and feral cats, are often associated with developed beaches and have been identified as a substantial source of mortality for piping plover eggs and chicks (U.S. Fish and Wildlife Service, 2009b; Winter & Wallace, 2006).

3.9.2.2.2.5 Species-Specific Threats

The localized declines of the Atlantic coast piping plover population is attributed to habitat loss and degradation and increased predator populations in coastal environments (U.S. Fish and Wildlife Service, 1996). Excessive disturbance may cause the parents to flee the nest, exposing eggs or chicks to the hot sun or predators. High disturbance levels around nest sites can also result in the abandonment of nests and, ultimately, decreased breeding success (Cohen & Gratto-Trevor, 2011). Causing parents or juveniles to flush while foraging may stress juveniles enough to negatively influence critical growth and development. Few areas used by wintering piping plovers are free of human disturbance, and nearly 50 percent have leashed and unleashed dog presence (U.S. Fish and Wildlife Service, 2009b).

Along the Atlantic coast, commercial, residential, and recreational development have decreased the amount of coastal habitat available for piping plovers. Trends show continued loss and degradation of habitat in migration and wintering areas due to sand placement projects, inlet stabilization, sand mining, erosion prevention structures (groins, seawalls, and revetments, exotic and invasive vegetation, and wrack removal) (U.S. Fish and Wildlife Service, 2009b). Unusual events, such as hurricanes, can impact hundreds of young-of-the-year and adults. Storms can also, over time, positively impact local piping plover populations by leveling dunes and creating suitable nesting habitat (U.S. Fish and Wildlife Service, 1996). Beach development and stabilization activities, dredging, recreational activities, and pollution are factors that impact the plover population on wintering grounds (U.S. Fish and Wildlife Service, 1996). There are also unknown sources of mortality experienced during migration or on the wintering grounds

(Calvert et al., 2006; Root et al., 1992). Recent data suggest that lighting on vessels and on offshore oil and gas platforms may cause mortality and could help explain some of these unknown mortality events (Merkel & Johansen, 2011). New potential threats include wind turbine development projects which introduce the possibility of collision, disturbance, and displacement of plovers (Burger et al., 2011). Another threat is climate change resulting in sea level rise that would directly impact Atlantic coast piping plovers breeding and wintering habitat (U.S. Fish and Wildlife Service, 2009b).

3.9.2.2.3 Roseate Tern (*Sterna dougallii*)

Five subspecies of the roseate tern have been described, though some taxonomic designations are uncertain: *S. d. dougallii* in the North Atlantic, Europe, and the Caribbean; *S. d. korustes* in India, Sri Lanka, and Burma; *S. d. gracilis* in Australia and Indonesia; and *S. d.arideensis* on the Seychelles Islands (Cornell Lab of Ornithology, 2014). All subspecies are similar in appearance to *S. d. dougallii*, with slight differences in wing length and bill color. The North Atlantic and Caribbean population of *S. d. dougallii* is the subspecies that occurs within the Study Area (U.S. Fish and Wildlife Service, 2010a).

3.9.2.2.3.1 Status and Management

In the year 1987, the USFWS listed the roseate tern as endangered under the ESA along the Atlantic coast of the United States (Maine to North Carolina); in Canadian provinces of Newfoundland, Nova Scotia, and Quebec, as well as in Bermuda (U.S. Fish and Wildlife Service, 2010c). The species is listed as threatened under the ESA in the Western Hemisphere, including Florida, Puerto Rico, and the Virgin Islands (U.S. Fish and Wildlife Service, 2010c). No critical habitat has been designated for this species in the United States. In the year 2006, Canada designated critical habitat for the species (U.S. Fish and Wildlife Service, 2010a). Recovery and management plans have been implemented to protect breeding colonies, foraging areas, and wintering grounds (Cornell Lab of Ornithology, 2014). The plans intend to increase breeding population size, distribution, and productivity by maintaining, expanding, and enhancing nesting habitat (U.S. Fish and Wildlife Service, 1998). Recovery and management methods include posting nesting areas with signs and fencing, discouraging and controlling competing gull species, managing vegetation to enhance nesting habitat, and attempting to attract individuals to historically occupied sites (U.S. Fish and Wildlife Service, 1998).

3.9.2.2.3.2 Habitat and Geographic Range

Roseate terns arrive at their breeding grounds in late April and early May (early to mid-May in the Caribbean population) and spend approximately 2 weeks feeding before they occupy nesting grounds (U.S. Fish and Wildlife Service, 1998). Northeastern roseate terns migrate in late August and early September, traveling in groups through the eastern Caribbean and along the north coast of South America to wintering grounds along the northern and eastern South American coast (Cornell Lab of Ornithology, 2014; Kirkham & Nettleship, 1987; National Audubon Society, 2017; U.S. Fish and Wildlife Service, 1998, 2010a). The migratory pathway of Caribbean birds is not known, but the route is almost certain to be 2,000 to 4,000 km (1,243 to 2,485 mi.) shorter than the route taken by the northeastern population (U.S. Fish and Wildlife Service, 2010a).

Roseate terns are colonial breeders. The North Atlantic populations are known to nest on a limited number of small islands off New York and Massachusetts, while the Caribbean population similarly nests in Puerto Rico, the Dry Tortugas, and the Florida Keys, as well as other non-U.S. affiliated Caribbean islands (Cornell Lab of Ornithology, 2014). They nest on islands near or under cover, such as vegetation, rocks, driftwood, and even human-made objects. They have also been documented nesting on sand dunes found at the end of barrier beaches (U.S. Fish and Wildlife Service, 1998). North American roseate terns use moderately to heavily vegetated sites for nesting (Burger & Gochfeld, 1988). Unlike the northeastern population, Caribbean roseate tern nests are exposed. Nests are near vegetation or rocks, on open sandy beaches, narrow rock ledges close to the water line, or among coral rubble (U.S. Fish and Wildlife Service, 1993).

Open Ocean. Within the Study Area, North American roseate terns occur within open ocean areas (Gulf Stream and North Atlantic Gyre) more often during migration and staging for migration than during winter or the breeding season. Between May and September, small numbers of common and roseate terns are widely distributed at sea, southeast of Cape Cod and throughout the Gulf of Maine, east to the southeast edge of Georges Bank. Flocks of terns, including roseate terns, have been observed resting on the sea. Such occurrences at sea are typically associated with the occurrence of predatory fish (e.g., tuna) that drive prey species to the surface (U.S. Fish and Wildlife Service, 2010a).

Northeast U.S. Continental Shelf Large Marine Ecosystem. Most breeding North American roseate terns occur in this large marine ecosystem from late April/early May to late August/early September (Table 3.9-1). Approximately 80 percent of the northeast population breeds at two large colonies on Great Gull Island, New York; and Bird Island, Massachusetts; with the remaining percentage breeding at 15–20 smaller colonies in Canada and the United States (Connecticut, Massachusetts, Maine, and New York) (Cornell Lab of Ornithology, 2014). Sand flats and beaches of southeastern Massachusetts, particularly along outer Cape Cod and nearshore islands provide important roosting and loafing habitats during fall staging. The Nantucket Shoal between the Massachusetts mainland and the islands of Martha's Vineyard and Nantucket is a particularly important foraging area for the entire northeastern population (U.S. Fish and Wildlife Service, 2010a).

Southeast U.S. Continental Shelf, Gulf of Mexico, and Caribbean Sea Large Marine Ecosystems. Wintering North American roseate terns occur along the southeast Atlantic and gulf coasts (U.S. Fish and Wildlife Service, 2010c). The Caribbean population of roseate tern breeds from the Florida Keys through the West Indies to islands off Central America and northern South America (U.S. Fish and Wildlife Service, 1993). Within the Study Area, the Gulf of Mexico and Caribbean Sea Large Marine Ecosystems contain the population in the Florida Keys and Dry Tortugas, and Puerto Rico.

3.9.2.2.3.3 Population Trends

The estimated global population of roseate terns is approximately 70,000 to 82,000 (BirdLife International, 2010). They are a widespread species that breed on every continent except Antarctica, with populations in the Indian Ocean, Caribbean, Australasian, European, African, and North American regions (Gochfeld, 1983). Approximately 3,200 pairs are estimated in the northeast U.S. population, with an additional 75 pairs in Canada and 250 pairs in Florida (Cornell Lab of Ornithology, 2014). Within the Caribbean population, approximately 1,000 pairs occur in Puerto Rico, with an estimated 500 to 2,300 pairs in the U.S. Virgin Islands (Cornell Lab of Ornithology, 2014). The roseate tern experienced drastic declines in the late nineteenth century due to commercial hunting of feathers for the millinery (hat-making) industry (U.S. Fish and Wildlife Service, 1998), as well as humans seeking eggs for food (Kirkham & Nettleship, 1987). Populations again showed decline in the 1940s and 1970s as the geographic range and the number of breeding colonies decreased (U.S. Fish and Wildlife Service, 1998).

Groups of roseate terns can be small due to their limited population size and limited nesting habitat in North America. In the northeast, breeding colonies of roseate terns range from 2 to more than 1,000 pairs, depending on breeding colony location (U.S. Fish and Wildlife Service, 1998). After chicks fledge from their breeding colonies, terns tend to congregate in large numbers at post-breeding staging areas to build up energy reserves for their seasonal fall migration to South America (U.S. Fish and Wildlife Service, 2010a). Northeastern roseate terns are always mixed with gulls and other species of terns, while populations in the Caribbean and the Seychelles Islands are known to form single-species colonies (Cornell Lab of Ornithology, 2014). Duffy (1986) found that roseate terns foraging in smaller flocks experienced higher survival rates, while in larger groups they were often out-competed by common terns.

3.9.2.2.3.4 Predator and Prey Interactions

The roseate tern is a coastal species that forages for small schooling fishes over shallow waters around bays, channels, sandbars, shoals, and reefs (Cornell Lab of Ornithology, 2014; Nisbet & Spendelow, 1999). They are also known to forage out over deeper waters than other tern species (Olsen & Larsson, 1995). Local commutes of up to 16 mi. (25 km) from nesting grounds to dependable foraging sites have been documented (Nisbet & Spendelow, 1999). Roseate terns generally concentrate in areas where prey is available close to the surface, driven there either by water movements or larger predatory fish.

Roseate terns are specialized aerial plunge-divers that often completely submerge themselves when seizing fish (U.S. Fish and Wildlife Service, 2010c). Roseate terns tend to plunge from heights above the water's surface ranging from 3 to 20 ft., although plunges from greater than 39 ft. have been observed (Cornell Lab of Ornithology, 2014). Roseate terns do not plunge deep into the water column, usually less than 3 feet. Given the shallow depth of dives, submergence times of roughly 1-2 seconds can be anticipated. Roseate terns will often fly into the wind and hover (a behavior known as "kiting") with rapid wingbeats and then, with accelerated flapping, aerial plunge into the water (Kaufman, 1990; U.S. Fish and Wildlife Service, 1998). Prey species are herring, mackerel, anchovies, and sand eels (Cornell Lab of Ornithology, 2014).

Roseate tern eggs and young are preyed upon by hermit and land crabs, ants, snakes, other birds (e.g., hawks, owls, gulls, and some shorebirds), and mammals such as rats and feral cats (U.S. Fish and Wildlife Service, 1993).

3.9.2.2.3.5 Species-Specific Threats

Roseate tern population declines have been attributed to commercial hunting and egg collection, habitat loss and disturbance, organochlorine contamination, predation, and competition from gulls (U.S. Fish and Wildlife Service, 1998). These threats, combined with the small number of breeding sites used by the species, warranted the listing of the species (Nisbet & Spendelow, 1999). Roseate terns are sensitive to disturbance on their nesting grounds, and many suitable nesting sites have been lost or abandoned due to the expansion of recreational, residential, and commercial use (Gochfeld, 1983). Beach erosion and the expansion of gull populations have also displaced roseate terns from suitable nesting habitat (Cornell Lab of Ornithology, 2014). Roseate terns are vulnerable to predation and flooding because they nest on the ground, often in low-lying areas (Gochfeld, 1983). Storms and prolonged periods of cold, wet weather also impact nest success (U.S. Fish and Wildlife Service, 1993). Climate change and sea level rise may exacerbate erosion of nesting grounds and could result in more severe or more frequent storms, which could disturb these habitats and result in reduced survival of adults, eggs, chicks, and fledglings (U.S. Fish and Wildlife Service, 2010a). Starvation is likely a greater cause of death during the winter in areas such as the southern Caribbean where nutrients are relatively poor (Gochfeld, 1983). Although little is known about roseate tern ecology during migration and wintering periods, one major cause of death is believed to be humans hunting this species on its wintering grounds (outside the United States) (Cornell Lab of Ornithology, 2014). Emerging potential threats include wind turbine development projects which introduce the possibility of collision, disturbance, and displacement of this species during the breeding and migratory seasons (Burger et al., 2011).

3.9.2.2.4 Red Knot (*Calidris canatus rufa*)

Red knots are found on the Atlantic coast of the United States and Canada. They belong to the subspecies *C. canutus rufa* (Cornell Lab of Ornithology, 2013). This subspecies of red knot, referred to as the rufa red knot, is listed as threatened under the ESA.

3.9.2.2.4.1 Status and Management

Four petitions to emergency list the red knot have been submitted since 2004, and in December of 2014, the USFWS listed the red knot as threatened under the ESA (*Federal Register* 79[238]: 73706-73748, December 11, 2014). Currently there is no designated critical habitat for the red knot, nor are there any developed conservation plans available from the USFWS. The five-year goal highlighted in the species action plan is to stabilize and improve the conservation status of the species through increasing habitat protection, reducing disturbance, and protecting key resources at migration and wintering sites (Cornell Lab of Ornithology, 2013). The Western Hemisphere Shorebird Reserve Network has established an international network of wetlands in an effort to protect important sites used by shorebirds, including the red knot (Tsipoura & Burger, 1999). Additionally, efforts to develop protection for Delaware Bay, an important migration staging area for red knots, are underway by the Western Hemisphere Shorebird Reserve Network (Cornell Lab of Ornithology, 2013).

3.9.2.2.4.2 Habitat and Geographic Range

The species breeds on the central Canadian arctic tundra but migrates down and winters along the Atlantic and gulf coasts from southern New England to Florida, and as far south as South America (Cornell Lab of Ornithology, 2013). Red knots will briefly use important stopover areas such as the Delaware Bay to forage before returning to their breeding grounds each year. An interior red knot population winters in Texas and Louisiana and migrates through the west and midwest to central Canada.

Open Ocean Areas. Red knots migrate some of the longest distances known for birds, with many individuals annually flying more than 9,300 mi. (15,000 km) (Cornell Lab of Ornithology, 2013), during which they may cross over each of the open ocean areas in the Study Area. However, outside of migration they are typically found in nearshore habitats along coastlines. Fall migration peaks in August with birds flying south along the Atlantic coast to major wintering grounds on the coasts of Argentina and southern Chile (Cornell Lab of Ornithology, 2013).

Northeast U.S. Continental Shelf Large Marine Ecosystem. During migration stopovers, the red knot uses marine habitats and generally prefers coastal, sandy habitats near tidal bays, inlets, and estuaries for foraging (Cornell Lab of Ornithology, 2013). Red knots migrate in large flocks and stop over at the same coastal sites along the Atlantic coast during spring migration to feed on eggs of horseshoe crabs (*Limulus polyphemus*). In particular, Delaware Bay is one of the largest known spring (mid-May to early June) stopover sites for this species (*Federal Register* 71[176]: 53756-53835, September 12, 2006) (Clark et al., 1993). Up to 80 percent of the entire estimated red knot population has been observed at once in the Delaware Bay during spring migration, leading to the area being designated as the first hemispheric site in the Western Hemisphere Shorebird Reserve Network (Clark et al., 1993; Niles et al., 2008; Tsipoura & Burger, 1999).

Southeast U.S. Continental Shelf and Gulf of Mexico Large Marine Ecosystems. During fall and spring migration and winter months, red knots occur in nearshore coastal habitats, along the Atlantic and gulf coasts from southern New England to Florida and into the Gulf of Mexico (Cornell Lab of Ornithology, 2013). The Virginia Atlantic barrier islands are a second major stopover location, with red knot peak counts between 5,500 and 9,100 birds since 1995 (Niles et al., 2008). They primarily occur in intertidal surf-zone habitats, particularly near coastal inlets, estuaries, and bays.

3.9.2.2.4.3 Population Trends

The red knot population was previously estimated at 100,000 to 150,000 individuals in the 1980s (Niles et al., 2008). However, annual aerial and ground surveys of Delaware Bay show fluctuation but generally a downward trend. Population surveys during the stopover period in the spring of 1998 at Delaware Bay estimated 50,000 red knots. In 2004, the same survey was repeated and the estimated population was substantially lower at 18,000 (Niles et al., 2008). Surveys of red knots at both migration stopover sites and wintering grounds continually show substantial population declines in recent decades (*Federal Register* 71[176]: 53756-53835, September 12, 2006). For example, surveys during the mid-1980s of wintering red knot populations in South America (Argentina and Chile) provided an estimate of 67,500 individuals (Niles et al., 2008); but according to the USFWS, since 2005, numbers have been under 20,000 birds, and dipped below 10,000 in 2011. Studies from 1994 to 2002 also show decreased annual adult survival rates related to these population declines (Niles et al., 2008).

3.9.2.2.4.4 Predator and Prey Interactions

Red knots forage by surface pecking and probing for intertidal invertebrates and various species of mussels and other molluscs (Cornell Lab of Ornithology, 2013). During spring migration, a major food source for red knots are horseshoe crab eggs; millions of which can be found in the Delaware Bay during the second half of May (Botton et al., 1994). Red knot migration coincides with the horseshoe crabs laying their eggs, allowing birds to restore their fat reserves to continue their northward migration to their breeding grounds in the arctic (Cornell Lab of Ornithology, 2013; Tsipoura & Burger, 1999).

Outside of the breeding grounds, red knot predators include peregrine falcon (*Falco peregrinus*), merlin (*Falco columbarius*), northern harrier (*Circus cyaneus*), short-eared owl (*Asio flammeus*), great black-backed gull (*Larus marinus*), and accipiters (*Accipiter* spp.) (Niles et al., 2008). Predators on breeding grounds include arctic fox (*Alopex lagopus*), long-tailed jaeger (*Stercorarius longicaudus*), and parasitic jaeger (*Stercorarius parasiticus*) (Piersma et al., 1993).

3.9.2.2.4.5 Species-Specific Threats

The red knot is threatened under the ESA mainly by habitat loss and degradation of foraging resources such as reduction of horseshoe crab populations (U.S. Fish and Wildlife Service, 2010b). Horseshoe crabs are harvested for their blood for biomedical research and their eggs for bait in the conch and eel fishing industries; consequently, the reduction in the amount of horseshoe crab eggs available for red knots, especially in Delaware Bay, is believed to be the cause of lower weight gain in red knots during migratory stopovers and contributing to lower adult survival (Niles et al., 2008). Beach erosion, shoreline protection and stabilization projects, human disturbance, limited food resources, oil spills, red tides, hunting, and severe weather all threaten the stability of the population (Niles et al., 2008; U.S. Fish and Wildlife Service, 2010b). Because large percentages of the entire population gather at single sites during migration (i.e., Delaware Bay) and winter, the species is especially vulnerable to loss of key resources at these sites (Clark et al., 1993; Cornell Lab of Ornithology, 2013; Niles et al., 2008).

3.9.2.2.5 Indiana Bat (*Myotis sodalis*)

3.9.2.2.5.1 Status and Management

The Indiana bat was originally listed as in danger of extinction under the Endangered Species Preservation Act of 1966 and is currently listed as endangered under the ESA. In 2009, its recovery priority was changed from 8 (meaning that the species has a moderate degree of threat and high recovery potential) to 5 (meaning that the species has a high degree of threat and a low recovery potential) due to the emergence and poor understanding of white-nose syndrome (U.S. Fish and Wildlife Service, 2009a). Critical habitat was designated for the species in 1976 (*Federal Register* 41[187]: 41914-41916, September 24, 1976). Eleven caves and two mines in six states (Illinois, Indiana, Kentucky, Missouri, Tennessee, and West Virginia) were listed as critical habitat. Significant information gaps remain regarding the species' ecology that hinder sound decision-making on how best to manage and protect the species (U.S. Fish and Wildlife Service, 2007).

3.9.2.2.5.2 Habitat and Geographic Range

Indiana bats hibernate, typically beginning in mid-October (in northern areas) or by the end of November (in southern areas) and ending by early May (for females) or mid-May (for males), with female peak emergence in mid-April and male peak emergence early May. It is thought that spring migration, which may occur either immediately upon emergence or a few days after emergence, may cause higher mortality due to low fat reserves and food supplies. Large numbers of Indiana bats complete their migration in mid-May, and fall migration begins during the first two weeks of August (U.S. Fish and Wildlife Service, 2007).

Extent hibernacula are patchily distributed northeast-southwest from Vermont to Tennessee, and east-west from Tennessee to Arkansas. Between 1995 and 2005, 281 hibernacula were active for at least one year. Of these, only one county (in Connecticut) containing one Priority 4 (i.e., lowest priority) hibernacula was located along the eastern coast of the U.S., and only one county (in New Jersey) containing two Priority 3 (i.e., second-lowest priority) hibernacula are adjacent to a county located along the eastern coast of the U.S. (U.S. Fish and Wildlife Service, 2007).

Extent maternity colonies are generally more clustered, located along the borders of Iowa, Missouri, and Illinois as well as throughout Indiana and southern Michigan, with scattered colonies in the northeastern U.S. None of the 269 extent maternity colonies are located in a county along the coast, and only 6 colonies (all in New Jersey) are located adjacent to a county along the coast (U.S. Fish and Wildlife Service, 2007).

Based on the description provided above, the Indiana bat is expected to occur in portions of the Study Area (refer to Table 3.9-1) infrequently, during summer months.

3.9.2.2.5.3 Population Trends

Estimates of prehistoric Indiana bat populations, based on paleontological evidence, range from 1.7 million to 9-13 million. One analysis of bone deposits at Bat Cave, Kentucky, in Mammoth Cave National Park, revealed an estimated 300,000 Indiana bats had died during a single flood event; it is uncertain whether this catastrophic population loss occurred during prehistoric times or during a large flood in 1937 that devastated much of the Ohio River valley (U.S. Fish and Wildlife Service, 2007).

When the Indiana bat was originally listed, its rangewide population was estimated at approximately 880,000. In 1983, when the first recovery plan was completed and approved, the rangewide population was estimated at about 550,000. Despite the acquisition and protection of over 35 caves and mines by government agencies or private conservation organizations, the rangewide Indiana bat population was estimated at 353,000 bats in 1997 (U.S. Fish and Wildlife Service, 2009a). These earlier estimates are considered low, however, due to discoveries of new hibernaculums. For example, one hibernaculum was discovered in Missouri in 2012 that contained a minimum of 123,000 bats when partially surveyed in January 2013 and over 167,000 bats when more completely surveyed in January 2015. Based on earlier accounts of very large numbers of unidentified bats using this hibernaculum for decades, the U.S. Fish and Wildlife Service decided to add the same number of bats as was found in 2015 (i.e., 167,000) to each previous biennium total for Missouri through 1981. Based on the best available data for the species, the U.S. Fish and Wildlife Service currently estimates that approximately 635,000 bats occurred rangewide in 2007 and that the population fell to approximately 524,000 in 2015 (U.S. Fish and Wildlife Service, 2015b).

3.9.2.2.5.4 Predator and Prey Interactions

Indiana bats feed on flying insects, with only a very small amount of spiders (presumably ballooning individuals) included in the diet. Four orders of insects contribute most to the diet: Coleoptera, Diptera, Lepidoptera, and Trichoptera. Terrestrial-based prey (moths and beetles) were more common in southern studies, whereas aquatic-based insects (flies and caddisflies) dominated in the north. It is presumed that this difference indicates southern bats foraged more in upland habitats, and northern bats hunted more in wetlands or above streams and ponds. Indiana bats are also known to consume other flying insects such as Hymenopterans (winged ants) and Asiatic oak weevils (*Cyrtepistomus castaneus*) when opportunistically available (U.S. Fish and Wildlife Service, 2007).

3.9.2.2.5.5 Species-Specific Threats

Threats to the Indiana bat vary during its annual cycle. Within the last 10 years, white-nose syndrome emerged as a significant threat as it as it causes precipitous declines in populations of cave-hibernating bat species (see Section 3.9.2.1.5.3, Disease and Parasites). Other threats at the hibernacula include modifications to caves, mines, and surrounding areas that change airflow and alter the microclimate within the hibernacula. Human disturbance and vandalism pose significant threats during hibernation through direct mortality and by inducing arousal and consequent depletion of fat reserves. Natural catastrophes can also have a significant effect during winter because of the concentration of individuals in a relatively few sites. During summer months, possible threats relate to the loss and degradation of forested habitat. Migration pathways and swarming sites may also be affected by habitat loss and degradation (U.S. Fish and Wildlife Service, 2007).

3.9.2.2.6 Northern Long-eared Bat (*Myotis septentrionalis*)

3.9.2.2.6.1 Status and Management

The northern long-eared bat was listed as threatened under the ESA on 4 May 2015. It occurs in 37 states, the District of Columbia, and 13 Canadian provinces (U.S. Fish and Wildlife Service, 2016a). The USFWS has determined that designating wintering habitat as critical habitat for the species would likely increase the threat of vandalism, disturbance, or the spread of white-nose syndrome. Furthermore, the USFWS has determined there are no areas within the summer habitat that meet the definition of critical habitat (U.S. Fish and Wildlife Service, 2016b). In January 2016, the USFWS established a white-nose syndrome zone under Rule 4(d) of the ESA. Incidental take of the northern long-eared bat is only allowed outside of the white-nose syndrome zone. The boundary of this zone is updated monthly as new data are collected and is available online at the U.S. Fish and Wildlife Service's Midwest Region website. As of May 2017, the white-nose syndrome zone included a vast majority of the northern long-eared bat's range and virtually the entire extent of its range along the east coast (Section 3.9.2.2.1.2, Habitat and Geographic Range) (U.S. Fish and Wildlife Service, 2017b).

3.9.2.2.6.2 Habitat and Geographic Range

Hibernation generally occurs from October through April, depending on the local climate. Suitable habitat for hibernation includes caves and cave-like structures (e.g., abandoned or active mines, railroad tunnels). The spring migration period typically runs from mid-March to mid-May. Suitable summer habitat for the northern long-eared bat consists of a wide variety of forested and wooded habitats as well as linear features such as fence rows, riparian forests, and other wooded corridors with variable amounts of canopy closure. Mature forests are an important habitat type for foraging northern long-eared bats (U.S. Fish and Wildlife Service, 2016a).

Unlike the true long-distance migratory bats (*Lasiurus* spp. and *Lasionycteris* spp.), the northern long-eared bat does not undertake long-distance migrations between summer and winter ranges but will make shorter distance movements between summer roosts and winter hibernacula (Yates, 2015). Within the United States, its range extends along the eastern coast from Canada to northeastern North Carolina, with additional small patches along the coast of southern North Carolina and southern South Carolina (U.S. Fish and Wildlife Service, 2017a, 2017b). Within the Study Area, northern long-eared bats are most likely to occur off the coast of the Northeastern United States and Canada (U.S. Department of Energy, 2016).

In a literature review, Pelletier et al. (2013) report that northern long-eared bats were found along the coastline or offshore on islands at:

- Kejimkujik National Park, Brier Island, and Bon Portage Island in Nova Scotia, Canada. Nova Scotia is a peninsula that is separated from the mainland to the south by 30 to 50 mi. of water. Brier Island and Bon Portage Island are separated from Nova Scotia by approximately 8 mi. and about 2 mi., respectively. Observed during summer months.
- Bay of Fundy National Park, New Brunswick, Canada, in summer to early fall.
- Martha's Vineyard, Massachusetts, approximately 4 mi. from mainland, during mist-netting surveys from April through October.
- Mount Desert Island, Maine (2 mi. off the coast), between May and September.

In addition, U.S. Department of Energy (2016) reports that ongoing mist-netting surveys at coastal sites in the northeast have also indicated relatively high numbers of northern long-eared bats post the introduction of white-nose syndrome compared to other, non-coastal areas in the northeast.

Northern long-eared bats have been detected during surveys at a variety of Navy installations along the eastern coast. These installations include:

- Naval Computer and Telecommunications Area Master Station Atlantic Detachment Cutler, located on the coast in Cutler, Maine, near the border with Canada. Data suggests there were likely some long-distance migratory tree-roosting bats spending the summer residency period at the installation and that other long-distance migratory bats moved through the Installation during the fall (Tetra Tech Inc, 2014). However, no northern long-eared bats were detected at the Installation in surveys by Yates (2015).

- Naval Weapons Station Earle in Colts Neck, New Jersey, where northern long-eared bats were present and roosting at the installation. The survey report authors note that the "presence of a sustained population of northern long-eared bats on Naval Weapons Station Earle is a testament to the amount of preferred habitat, contiguous forest, that the installation is able to provide compared to the surrounding areas."
- Naval Weapons Station Yorktown and Naval Supply Center Cheatham Annex in Williamsburg, Virginia (Tetra Tech Inc, 2017b). One bat was detected during the 2016 surveys, and a juvenile was detected during 2014 surveys. The authors report that the presence of the juvenile "suggests that there may be successful Northern long-eared bat maternity colonies in the area."
- Two installations along the coast in Virginia Beach, Virginia:
    - Joint Expeditionary Base Fort Story (Tetra Tech Inc, 2016a).
    - Naval Air Station Oceana Dam Neck Annex (Tetra Tech Inc, 2016b).

In addition to the above, although no northern long-eared bats were detected at Naval Air Station Oceana in Virginia Beach, Virginia, they were detected near the installation in 2014 and 2015, and there is suitable habitat available on the installation (Tetra Tech Inc, 2016c).

3.9.2.2.6.3 Population Trends

The U.S. Fish and Wildlife Service (2016c) estimated the rangewide northern long-eared bat population at over 6.5 million adults. The Midwest supports 43% of the total population, followed by the Southern range (38%), the Eastern range (17%), and the Western range (2%). Arkansas and Minnesota are the two states with the largest populations, with approximately 863,850 (13%) and 829,890 (13%) adults, respectively. In areas affected by white-nose syndrome, however, the population is likely overestimated as (1) there is a clear downward trend in these areas, (2) most data are at least a year old, and (3) three years of occupancy data were used.

3.9.2.2.6.4 Predator and Prey Interactions

The northern long-eared bat has a diverse diet including moths, flies, leafhoppers, caddisflies, and beetles, and its diet differs geographically and seasonally. It forages using both hawking (catching prey in flight) and gleaning (picking motionless insects from vegetation and water surfaces) behaviors (U.S. Fish and Wildlife Service, 2016a, 2017a). Lepidopterans (moths) and coleopterans (beetles) are the most common insects found in northern long-eared bat diets, although arachnids are also a common prey item. Most foraging occurs above the understory, 1 to 3 m above the ground, but under the canopy on forested hillsides and ridges, rather than along riparian areas.

3.9.2.2.6.5 Species-Specific Threats

The northern long-eared bat is one of the species of bats most impacted by white-nose syndrome (see Section 3.9.2.1.5.3, Disease and Parasites), which has caused declines of 90 to 100% where the disease has been found and is the primary factor supporting the endangered species status determination. Declines in the numbers of northern long-eared bats are expected to continue as white-nose syndrome extends across the species' range (U.S. Fish and Wildlife Service, 2016a).

3.9.2.3 Species Not Listed Under the Endangered Species Act

At least 160 species of birds, and at least 24 species of bats, are found within the Study Area that are not listed under the ESA. The major groups of birds are described in Section 3.9.2.3.1 (Major Groups), and

Section 3.9.2.3.3 (Migratory Birds) describes species that are protected and of conservation concern under the Migratory Bird Treaty Act. Section 3.9.2.3.2 (Bats) describes the bats that are known or are expected to occur in the Study Area.

3.9.2.3.1 Major Bird Groups

There are 11 major taxonomic groups of birds represented in the Study Area Table 3.9-2. These birds may be found in the air, at the water's surface, or in the water column of the Study Area. The vertical distribution descriptions in Table 3.9-2 provide a representative description of the taxonomic group; however, due to variations in species behavior, these descriptions may not apply to all species within each group. Distribution in the water column is indicative of a species known to dive under the surface of the water (for example, during foraging). More detailed species descriptions, including diving behavior, are provided in Sections 3.9.2.3.1.1 (Geese, Swans, Dabbling, and Diving Ducks [Order Anseriformes]) through 3.9.2.3.1.11 (Neotropical Migrant Songbirds, Thrushes, Allies, Cuckoos, Swifts, and Owls [Orders Passeriformes, Cuculiformes, and Apodiformes]).

All 11 major taxonomic groups of birds in the Study Area occur in open ocean areas (Labrador Current, North Atlantic Gyre, Gulf Stream) or coastal waters of large marine ecosystems (West Greenland Shelf, Newfoundland-Labrador Shelf, Scotian Shelf, Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Gulf of Mexico, Caribbean Sea), as shown in Table 3.9-2 Refer to Figure 3.0-1 for a map of open ocean areas and large marine ecosystems in the Study Area.

Table 3.9-2: Major Taxonomic Groups of Birds in the Study Area

Major Bird Groups		***Vertical Distribution in the Study Area***		
Common Name (Taxonomic Group)	***Description***	***Open Ocean Areas***	***Large Marine Ecosystem***	***Inshore Waters***
Geese, swans, dabbling and diving ducks (Order Anseriformes)	Diverse group of birds that inhabit shallow waters, coastal areas, and deeper waters. Feed at the surface by dabbling or by diving in deeper water. Often occur in large flocks.	Airborne, surface, water column	Airborne, surface, water column	Airborne, surface, water column
Loons (Order Gaviiformes)	Duck-like, fish-eating birds that capture prey by diving and underwater pursuit.	Airborne, surface, water column	Airborne, surface, water column	Airborne, surface, water column
Grebes (Order Podicipediformes)	Small diving birds, duck-like. May occur in small groups.	Airborne, surface, water column	Airborne, surface, water column	Airborne, surface, water column

Table 3.9-2: Major Taxonomic Groups of Birds in the Study Area (continued)

Major Bird Groups		*Vertical Distribution in the Study Area*		
Common Name (Taxonomic Group)	***Description***	***Open Ocean Areas***	***Large Marine Ecosystem***	***Inshore Waters***
Albatrosses, fulmars, petrels, shearwaters, and storm-petrels (Order Procellariiformes)	Group of largely pelagic seabirds. Fly nearly continuously when at sea. Soar low over the water surface to find prey. Some species dive below the surface.	Airborne, surface, water column	Airborne, surface, water column	Airborne, surface, water column
Boobies, gannets, cormorants, anhingas, and frigatebirds (Order Suliformes)	Diverse group of large, fish-eating seabirds with four toes joined by webbing. Often occur in large flocks near high concentrations of bait fish.	Airborne, surface, water column	Airborne, surface, water column	Airborne, surface, water column
Tropicbirds (Order Phaethontiformes)	Oceanic birds, found far offshore, over warm water and are often seen resting on the water. Flight is high and steady and they plunge into water to catch fish.	Airborne, surface, water column	Airborne, surface, water column	Airborne, surface, water column
Pelicans, herons, egrets, Ibis, and spoonbills (Order Pelecaniformes)	Large wading birds with dagger-like, down-curved, or spoon-shaped bills used to capture prey in water or mud.	None	Airborne, surface, water column	Airborne, surface, water column
Flamingos (Order Phoenicopteriformes)	Large, wading birds with unique angled bill to filter invertebrates from water or mud.	None	Airborne, surface	Airborne, surface
Osprey, bald eagles, peregrine falcons (Orders Accipitriformes, and Falconiformes)	Large raptors that inhabit habitats with open water, including coastal areas. Feed on fish, waterfowl, or other mammals. Migrate and forage over open water.	None	Airborne, surface	Airborne, surface
Osprey, bald eagles, peregrine falcons (Orders Accipitriformes, and Falconiformes)	Large raptors that inhabit habitats with open water, including coastal areas. Feed on fish, waterfowl, or other mammals. Migrate and forage over open water.	None	Airborne, surface	Airborne, surface
Shorebirds, phalaropes, gulls, noddies, terns, skua, jaegers, and alcids (Order Charadriiformes)	Diverse group of small to medium-sized shorebirds, seabirds and allies inhabiting coastal, nearshore, and open ocean waters	Airborne, surface, water column	Airborne, surface, water column	Airborne, surface, water column

Table 3.9-2: Major Taxonomic Groups of Birds in the Study Area (continued)

Major Bird Groups		*Vertical Distribution in the Study Area*		
Common Name (Taxonomic Group)	***Description***	***Open Ocean Areas***	***Large Marine Ecosystem***	***Inshore Waters***
Neotropical Migrant Songbirds, Warblers, Thrushes, Cuckoos, Owls, Swifts, and Allies (Orders Passeriformes Cuculiformes, Strigiformes, and Apodiformes)	Largest and most diverse group of birds in North America, primarily occur in coastal, and inland areas, but occur in large numbers over the open ocean (particularly over the Gulf of Mexico) during annual spring and fall migration periods.	Airborne	Airborne	Airborne

Sources: American Ornithologists' Union (2017), Sibley (2014) for major bird taxonomic groups.

3.9.2.3.1.1 Geese, Swans, Dabbling and Diving Ducks (Order Anseriformes)

There are 50 species of swans, geese, and dabbling, diving, and seaducks in the family Anatidae in North America. No birds from this group are considered Birds of Conservation Concern (U.S. Fish and Wildlife Service, 2008b). Birds from this group range from dabbling ducks found in coastal bays, estuaries, and lagoons to more open water ducks found in deeper water environments. Twenty-three of these species are diving ducks that inhabit nearshore or offshore waters of the Study Area (Sibley, 2014). Eiders, scoters, long-tailed duck (*Clangula hyemalis*), and harlequin duck (*Histrionicus histrionicus*) are seaducks that winter in nearshore ocean waters. All these species can be found in deeper water where they dive to forage (Sibley, 2014), some also forage on the ocean bottom in shallow water. Most diving duck species dive down to depths up to 33 ft. (10 m) but long-tailed ducks have been reported to dive down to depths up to 218 ft. (66 m) with a dive time of around 35 seconds (Sibley, 2014). Some inshore shark species, as well as alligators and crocodiles, prey on ducks on the surface of the water (Ehrlich et al., 1988).

Seaducks and some diving ducks (e.g., scaups) breed inland but winter in large numbers in the Atlantic coastal waters of the Study Area and dive to the bottom, feeding primarily on benthic invertebrates. The harlequin duck is small and agile and prefers very turbulent water such as freshwater streams during the breeding season. Their winter habitat includes coastal intertidal areas, but they roost at night on open water farther offshore (greater than 0.6 mi. [1 kilometer]) (Robertson & Goudie, 1999). The long-tailed duck winters in small groups in shallow ocean habitat.

Representative species that can be found in coastal bays, estuaries, and lagoons include geese (e.g., Canada goose [*Branta tellate*], brant [*Branta bernicla*]); swans (e.g., trumpeter swan [*Cygnus buccinators*], tundra swan [*Cygnus columbianus*]); dabbling ducks (e.g., mallard [*Anas platyrhynchos*], gadwall [*Anas strepera*], mottled duck [*Anas fulvigula*], American black duck [*Anas rubripes*], American wigeon [*Anas tellate*], northern shoveler [*Anas clypeata*], blue-winged teal [*Anas discors*], and green-winged teal [*Anas crecca*]); diving ducks (e.g., redhead [*Aythyatellate*], bufflehead [*Bucephala albeola*], common goldeneye [*Bucephala clangula*], and red-breasted merganser [*Mergus serrator*]); eiders (e.g., common eider [*Somateria mollissima*], king eider [*Somateria spectabilis*]); and scoters (e.g., surf scoter [*Melanitta perspicillata*], black scoter [*Melanitta tellate*]) (American Ornithologists' Union, 1998).

3.9.2.3.1.2 Loons (Order Gaviiformes)

There are five species of loons in the family Gaviidae in North America (American Ornithologists' Union, 1998), three of which occur in the Study Area. The common loon (*G. immer*) and the red-throated loon (*G. stellata*) are Birds of Conservation Concern (U.S. Fish and Wildlife Service, 2008b). Loons are medium to large fish-eating birds that capture prey by diving underwater (Sibley, 2014). Loons can dive down to 250 ft. (76 m) with an average dive time of 40 seconds (Sibley, 2014). Loons move ashore only to breed, and all loon species nest on banks of inland ponds or lakes, requiring specific habitat features such as undeveloped shoreline and nest sites that have steep drop offs so they can approach their nest from underwater (Cornell Lab of Ornithology, 2009). For example, common loons spend their time in both freshwater and saltwater environments but prefer to nest on islands where the shoreline is not developed. Most loons need about 100 ft. (30.5 m) of room to take off, so size is another habitat feature that is important for nesting areas. During migration, loons fly high above land or water in loose groups or singly. They winter in coastal, nearshore, or open water marine habitats (Sibley, 2014). For example, the Pacific loon (*G. pacifica*) prefers deep water and is found on the open ocean and in bays. The red-throated loon, a representative species within the Study Area, has a circumpolar distribution, breeds in high latitudes on remote ponds, and winters along the Atlantic and Pacific coasts (American Ornithologists' Union, 1998).

3.9.2.3.1.3 Grebes (Order Podicipediformes)

There are seven species of grebes in the family Podicipedidae in North America (American Ornithologists' Union, 1998). Two of these species, the pied-billed grebe (*Podilymbus podiceps*) and horned grebe (*Podiceps auritus*) are Birds of Conservation Concern (U.S. Fish and Wildlife Service, 2008b). Grebes can be found in a variety of aquatic habitats ranging from seasonally flooded scrubland and roadside ditches to deep lakes and coastal bays. Most grebe species winter in open waters while preferring marshy, vegetated habitats during the summer months (Sibley, 2014). Grebes forage by diving for small aquatic animals such as insects, fish, and crustaceans in the water column. For example, horned grebes can dive for up to 3 minutes and travel 500 ft. underwater, where they are sometimes preyed upon by sharks and orcas (Ehrlich et al., 1988). Grebes tend to escape predators by diving or sinking, leaving only the head exposed, rather than taking flight. All grebe species build floating nests in marshes and winter on the ocean and nearshore coastal areas (Sibley, 2014).

3.9.2.3.1.4 Albatrosses, Fulmars, Petrels, Shearwaters, and Storm-Petrels (Order Procellariiformes)

Procellariiformes is a large order of open ocean seabirds that are divided into four families: Diomedeidae (albatrosses), Procellariidae (petrels and shearwaters), Hydrobatidae (storm-petrels), and Pelecanoididae (diving petrels) (Enticott & Tipling, 1997; Onley & Scofield, 2007). This order includes species that are generally long-lived, breed once a year, and lay only one egg; thus, they have a low reproductive output. One of these species is listed as endangered under the ESA (Section 3.9.2.2.1, Bermuda Petrel [*Pterodroma cahow*]) (U.S. Fish and Wildlife Service, 2010d) and four are Birds of Conservation Concern as shown in (U.S. Fish and Wildlife Service, 2008b).

Many seabirds spend most of their lives at sea and come to land only to breed, nest, and occasionally roost (Schreiber & Chovan, 1986). Colonial breeding is believed to have evolved in response to the limited availability of relatively predator-free nesting habitats and distance to foraging sites from breeding grounds (Siegel-Causey & Kharitonov, 1990). Benefits of colonial breeding include increased detection of predators and decreased chance of predation of young while parent birds are foraging away from the nest (Gill, 1995).

Seabirds can be found in high numbers resting on the water surface in flocks where prey is concentrated (Enticott & Tipling, 1997). Some species are found around fishing boats, where they often feed on bycatch and may become injured from longline gear (Enticott & Tipling, 1997; Onley & Scofield, 2007). Also, because of their pelagic nature, this group is preyed on by some pelagic shark species (Ehrlich et al., 1988). Oceanic fronts (gradients in current speed, temperature, salinity, density, and enhanced circulation) attract seabirds due to increased foraging opportunities. For example, the at-sea distribution of some seabirds is associated with oceanic fronts, which support increased numbers of prey and provide favorable foraging conditions (Bost et al., 2009).

There are 20 species of Procellariiformes in North America, with 13 species representing two families-the storm-petrels and petrels and shearwaters (American Ornithologists' Union, 1998)-occurring within the Study Area. Most of the petrel species in the Study Area are not considered part of the diving petrels and forage along the surface of the ocean. Petrels are colonial nesters and tend to nest on remote islands uninhabited by people.

Storm-petrels pick prey off the surface while foraging. Most breed in natural holes/cryptic burrows and visit their colonies only at night (Enticott & Tipling, 1997; Onley & Scofield, 2007). Fulmarine petrels, such as the northern fulmar (*Fulmarus glacialis*) and the black-capped petrel (*Pterodroma hasitata*), feed by landing on the sea and grabbing prey near the surface. Most fulmarine petrels nest in burrows or on cliff ledges and visit nests by day (Enticott & Tipling, 1997; Onley & Scofield, 2007). Gadfly petrels are generally species of the *Pterodroma* genus and are long-winged, fast flying, and highly pelagic. They feed on the wing and land on the sea (Onley & Scofield, 2007). Some gadfly petrels nest in burrows or crevices and visit colonies at night (Enticott & Tipling, 1997; Onley & Scofield, 2007).

Shearwaters are small- to medium-sized and dive to varying depths for prey (Onley & Scofield, 2007). For example, Cory's shearwater (*Calonectris diomedea*) rarely dives to 16 ft. (5 m) below the surface, while sooty (*Puffinus griseus*) and short-tailed shearwaters (*Puffinus tenuirostris*) can reach depths of 230 ft. (70 m), swimming underwater with half-open wings (Enticott & Tipling, 1997; Onley & Scofield, 2007). Greater shearwaters in the South Atlantic Ocean have been reported to dive down to 62 ft. (19 m) and as long as 40 s in a single dive. However, the majority of their dives were less than 6.6 ft. (2 m) (Ronconi et al., 2010).

3.9.2.3.1.5 Boobies, Gannets, Cormorants, and Frigatebirds (Order Suliformes)

The Suliformes order is a diverse group of large seabirds including anhingas, gannets, boobies, cormorants, and frigatebirds. This order is composed of 16 species in 4 families—12 species representing 2 families that occur within the Study Area. Four of these species are considered Birds of Conservation Concern (U.S. Fish and Wildlife Service, 2008b). Species of concern within the Study Area include the brown booby (*Sula leucogaster*), masked booby (*Sula dactylatra*), great cormorant (*Phalacrocorax carbo*), and magnificent frigatebird (*Fregata magnificens*) (American Ornithologists' Union, 1998).

Suliformes are less pelagic than the Procellariiformes, although some of these species such as frigatebirds are pelagic. Most species are colonial, feed on fish, and use a variety of breeding habitats including trees and bushes (but not burrows). Breeding strategies vary among species, with some being long-lived and having low breeding success, while others have higher annual breeding success, but higher annual adult death (Enticott & Tipling, 1997; Onley & Scofield, 2007).

Cormorants are voracious predators on inshore fishes and have been implicated as a major threat to the recovery efforts of Atlantic salmon in the Gulf of Maine where they feed on juvenile salmon (smolts) leaving the estuaries (Fay et al., 2006; National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2005). Their offshore foraging range is limited by their need for undisturbed, dry nocturnal roosting sites (Shields et al., 2002).

Boobies and gannets are large seabirds that plunge from the air to capture their prey. Filling similar niches, boobies inhabit warmer areas and gannets colder regions. Boobies and gannets often nest on islands in colonies, with gannets nesting on cliffs (BirdLife International, 2012) and boobies generally on the ground if predators allow (Pratt et al., 1987). They forage offshore in large flocks at night, often feeding on squid.

Like tropicbirds and pelicans, members of this group all have webbed feet and eight toes, and all have a throat sac, called a gular sac (Brown & Harshman, 2008). This sac is highly developed and visible in pelicans and frigatebirds but is also readily apparent in boobies and cormorants. Pelicans use the sac to trap fish, frigatebirds use it as a mating display and to feed on fish, squid, and similar marine life (Dearborn et al., 2001), and cormorants and boobies utilize the sac for heat regulation. These birds nest in colonies, but individual birds are monogamous (Brown & Harshman, 2008).

3.9.2.3.1.6 Tropicbirds (Order Phaethontiformes)

Tropicbirds are medium-sized seabirds, predominately white with black patterning on the back, wings, and face. They have thick, pointed bills that are red or orange in color that are slightly decurved. Their most notable feature is the extremely long and narrow central tail feathers, which can be 11 to 22 inches (in.) long. Their wingspans average around 3 feet. Superficially, tropicbirds resemble terns. Tropicbirds are highly pelagic foragers in tropical and subtropical oceans, coming to land mainly to breed (Sibley, 2014). Tropicbirds are plunge-divers that feed on fish and could occur as rare visitors offshore in the Study Area in the Gulf of Mexico, Caribbean Sea, and Southeast U.S. Continental Shelf Large Marine Ecosystems, and in the Gulf Stream and North Atlantic Gyre Open Ocean Areas (Sibley, 2014). No birds from this group are considered Birds of Conservation Concern (U.S. Fish and Wildlife Service, 2008b).

3.9.2.3.1.7 Pelicans, Herons, Egrets, Ibis, and Spoonbills (Order Pelecaniformes)

Pelecaniformes is a large group composed of long-legged, large billed species that includes pelicans, herons, egrets, ibis, and spoonbills. However, with the exception of two species of pelicans (described below), they are inhabitants of freshwater marshes and are unlikely to occur in the Study Area. Five of these species (roseate spoonbill, reddish egret, snowy egret, American bittern, and least bittern) are Birds of Conservation Concern as shown in Table 3.9-4 (U.S. Fish and Wildlife Service, 2008b).

The brown pelican (*Pelecanus occidentalis*) primarily occurs in shallow (less than 150 ft. [46 m]) warm coastal marine and estuarine environments, as well as offshore where they forage primarily on fish by head first plunge-diving. Most plunge-diving is limited to 3.5 to 6.5 ft. (1 to 2 m) within the water column. Foraging occurs within 12 mi. (20 km) of nesting islands during the breeding season, and up to 47 mi. (75 km) offshore during the nonbreeding season (Shields et al., 2002). American white pelicans (*Pelecanus erythrorhynchos*) are found in shallow coastal bays, inlets, and estuaries that support forage fish (Knopf & Evans, 2004). Flocks forage cooperatively, swimming and encircling fish as a coordinated group or driving them into shallows, where they are caught with synchronized bill dipping (Enticott & Tipling, 1997; Onley & Scofield, 2007).

3.9.2.3.1.8 Flamingos (Order Phoenicopteriformes)

Flamingos are gregarious (social) wading birds in the genus *Phoenicopterus*, and the only genus in the family Phoenicopteridae. The American flamingo (*P. ruber)* species is found in the Study Area. The distribution range of the flamingo is extremely large and includes many Caribbean and South American countries. However, their occurrence in the United States is limited to the southern tip of Florida (Everglades National Park) (Sibley, 2014; Stevens & Pickett, 1994).

These wading birds forage in intertidal areas by rhythmically swinging their bills from side to side and filtering small organisms out of the mud (Sibley, 2014). Though most of their life cycle is spent along coastal areas, migration over offshore areas does occur (Elphick, 2007). They forage in shallow water, swinging their bill from side to side and filtering small organisms out of the mud (Sibley, 2014).

3.9.2.3.1.9 Osprey, Bald Eagles, Kites and Falcons (Orders Accipitriformes and Falconiformes)

Accipitriformes is a large group consisting of 60 species in three families (American Ornithologists' Union, 1998). This order generally has broad wings well-suited for soaring. Falconiformes include 9 North American species that, with the exception of the caracara (*Caracara cheriway*), are fast flying predators with pointed wings and a streamline body shape (Sibley, 2014). Members of both orders hunt by day and feed on a variety of prey, including fish, small mammals, reptiles, and carrion. Species that are likely to occur within the Study Area include the osprey (*Pandion haliaetus),* bald eagle (*Haliaeetus leucocephalus*), peregrine falcon (*Falco peregrinus*), and swallow-tailed kite (*Elanoides forficatus*). The bald eagle, peregrine falcon, and swallow-tailed kite are Birds of Conservation Concern.

Ospreys live near slow-moving waters of coastal, nearshore, and freshwater environments in many parts of the Study Area. They are plunge feeders but also have the ability to capture prey with their feet while keeping their head above water. Fish make up a large portion of their diet, and therefore, their vision is well adapted to detecting underwater objects from 33–131 ft. (10–40 m) above water (Poole et al., 2002). Ospreys migrate from northern latitudes to southern latitudes twice a year and cross bodies of open ocean to reach their destinations (Lott, 2006).

Bald eagles nest, forage, and winter along the Atlantic coast especially in the Chesapeake Bay region. Bald eagles also occur throughout Florida, although no bald eagle sightings have been recorded at Port Canaveral in 27 years (Federal Emergency Management Agency, 2012; Florida Fish and Wildlife Conservation Commission, 2017a). Bald eagles have steadily increased since the ban on DDT from 60 pairs in the 1970s to 646 in 2001. The Chesapeake Bay is very important to bald eagles because it is a convergence point for all three geographically distinct populations (northeast, southeast, and Chesapeake Bay) and has played an important part in their recovery (Watts et al., 2007). Bald eagles are opportunistic feeders that generally prefer fish over other food types (Buehler, 2000). Adults are known to scavenge prey items, pirate food from other species, and capture prey such as ducks from the water's surface.

Swallow-tailed kites breed in the southeastern United States but winter in South America, making long-distance migrations each year between wintering and breeding grounds. Studies in Florida show swallow-tailed kites feed on various animals in the following proportions: frogs (53 percent), birds (30 percent), and reptiles (11 percent) and the remaining prey were insects (Meyer et al., 2004).

Most peregrine falcons occur throughout the nearshore and coastal portions of the Study Area, particularly near barrier islands and mudflats during the winter months. Some peregrine falcons migrate along the coast, cross bodies of water such as the Gulf of Mexico, and occur offshore of the Atlantic coast to reach their wintering/breeding territories on a yearly basis (Lott, 2006). They can reach altitudes up to 12,000 ft. (Cornell Lab of Ornithology, 2011). Peregrine falcons feed mostly on other birds, including shorebirds, ducks, grebes, gulls, and petrels. They occasionally feed on fish while in coastal habitats (Cornell Lab of Ornithology, 2011).

3.9.2.3.1.10 Shorebirds, Phalaropes, Gulls, Noddies, Terns, Skimmers, Skuas, Jaegers, and Alcids (Order Charadriiformes)

Shorebirds are small, generally long-legged coastal birds, many of which forage below the high tide in the surf zone by picking and probing for small aquatic prey (Sibley, 2014). Shorebirds undergo some of the longest distance migrations known for birds, for example, the red knot annually migrates more than 9,300 mi. (U.S. Fish and Wildlife Service, 2005). Though most of their life cycle is spent in coastal areas, shorebird migration over open ocean does occur (Elphick, 2007). Although taxonomically grouped among some shorebirds, two species of phalaropes in the family Scolopacidae that occur within the Study Area are functionally seabirds, spending the nonbreeding months out on the open ocean. For example, the red-necked phalarope (*Phalaropus lobatus*) spends up to 9 months at sea, gathering in small flocks at upwellings and convergence zones, foraging on zooplankton and other small aquatic animals that rise to the surface (Rubega et al., 2000). The red phalarope ranges farthest from shore, spending 11 months at sea feeding on small invertebrates (Cornell Lab of Ornithology, 2002).

The Charadriiformes include shorebirds, phalaropes, gulls, noddies, terns, skimmers, skuas, jaegers, and alcids (Cornell Lab of Ornithology, 2009). There are 81 species from this diverse group that occur within the Study Area ranging from small shorebirds to large pelagic seabirds. Two endangered species under the ESA belong to this group, the roseate tern and piping plover (U.S. Fish and Wildlife Service, 2010a). Nineteen species from this group are Birds of Conservation Concern (U.S. Fish and Wildlife Service, 2008b). Some species in this order are highly pelagic (e.g., jaegers, skuas, alcids), whereas others are more coastal or nearshore species (e.g., shorebirds, gulls).

Skuas and jaegers are oceanic birds that come to land only to nest. On the nesting grounds they prey on lemmings, small birds, and other animals; in other seasons they pirate much of their food from other seabirds by chasing them and forcing them to relinquish captured prey (Sibley, 2014). Representative species from this group include: semipalmated plover (*Charadrius semipalmatus*), great skua (*Stercorarius skua*), long-tailed jaeger (*Stercorarius longicaudus*), sooty tern (*Onychoprion fuscatus*), brown noddy (*Anous stolidus*), dovekie (*Alle alle*), common murre (*Uria aalge*), razorbill (*Alca torda*), long-billed murrelet (*Brachyramphus perdix*), Atlantic puffin (*Fratercula arctica*), and red phalarope (*Phalaropus fulicarius*).

Noddies are tropical tern-like seabirds found foraging over warm, open ocean waters where they feed by swooping or dipping along the surface. Brown noddies breed in colonies on islands, islets, and rocky outcrops in warm seas. They only lay one egg a year and build their nests in trees, shrubs, cliffs, and manmade structures (Sibley, 2014).

Terns are generally more marine or pelagic than gulls, though some tern species do occur more commonly within coastal areas (e.g., least terns). Terns roost and nest in large groups on shorelines, and feed on small fish by plunge-diving head first from the air into the water, often beginning from a hovering position. They feed closer to shore when raising young during the nesting season, but venture farther offshore for longer periods after young have fledged (Sibley, 2014). In the North Atlantic, Gulf

Stream eddies attract foraging seabirds such as the sooty tern and bridled tern (*Onychoprion anaethetus*) (Bost et al., 2009).

Alcids or auks (family *Alcidae*), are small oceanic species that inhabit cold Northern Hemisphere seas, rarely wandering south into the tropics (Pratt et al., 1987). They come to land only to breed (Enticott & Tipling, 1997) and nest colonially in crevices or burrows. Alcids do not undergo long-distance foraging trips but form feeding aggregations in areas where food is concentrated, though they do not form tight flocks (Enticott & Tipling, 1997). All alcids use their wings to dive underwater where they feed on fishes and invertebrates. Auks are pursuit divers and are entirely wing-propelled rather than foot-propelled, as are loons and grebes, for example. Atlantic puffins can dive between 135 to 224 ft. (41 and 68 m) for periods of up to 1 minute (Burger & Simpson, 1986).

The Charadriiformes influence the distribution and abundance of invertebrates, and indirectly algae, in rocky intertidal communities of New England (Ellis et al., 2007). Gulls are one particular group that can be found over land, along the coast, in nearshore, and offshore environments. The great black-backed gull (*Larus marinus*) and the herring gull (*Larus argentatus*) are dominant predators along the rocky shores throughout the North Atlantic. They forage while walking, swimming, or flying, sometimes dipping into the water and sometimes plunge-diving (National Audubon Society, 2015). They often feed on crabs, sea urchins, and mussels in the rocky intertidal habitat; once a prey item is caught, the gull will fly up and drop it on rocks below to break it open.

3.9.2.3.1.11 Neotropical Migrant Songbirds, Thrushes, Cuckoos, Swifts, Owls, and Allies (Orders Passeriformes, Cuculiformes, Apodiformes and Strigiformes)

There are 185 bird species in the orders Passeriformes, Cuculiformes, Apodiformes, and Strigiformes that are considered nocturnal migrants and neotropical migrants with a potential to occur in the Study Area. Twenty-one of these species are Birds of Conservation Concern as shown in Table 3.9-4 (U.S. Fish and Wildlife Service, 2008b). Most of these species are nocturnal migrants and take advantage of favorable weather conditions to migrate (Kerlinger, 2009). Oceans are typically an obstacle for this group of birds because most songbirds cannot swim, or even rest on the water's surface. Migrants tend to avoid large water crossings and follow land to the extent possible. Migration has a substantial risk to birds, ranging from mass mortality events due to inclement weather events (Newton, 2007) and other mortality events associated with lighting of vessels (Merkel & Johansen, 2011) and oil and gas platforms (Poot et al., 2008). In the Gulf of Mexico, long-distance migrants are commonly found stopping over and resting on oil and gas platforms as well as on small boats and vessels. Most neotropical migrants, especially warblers and thrushes from the family *Parulidae* and family *Turdidae*, cross water at some point twice a year to reach their wintering and breeding grounds. For example, the Bicknell's thrush *(Cartharus bicknelli*) breeds in mountainous forests of New England and migrates across open oceans in the fall to reach their wintering grounds in the Caribbean.

Aerial insect feeders such as swifts and predatory birds such as owls may feed opportunistically during migration across the ocean (Elphick, 2007), but the vast majority of bird species in this diverse group do not feed within the Study Area.

3.9.2.3.2 Bats

At least 24 species of bats are known or expected to occur in the Study Area (Table 3.9-3), either during migration or foraging. Additional bat species are known to occur in areas near, or adjacent to, the Study Area. For example, the Mexican Long-tongued bat (*Choeronycteris mexicana*) migrates through Central Mexico but avoids the Gulf of Mexico coastline, with the exception of a small area in northeastern most

Mexico on the border of southernmost Texas (National Park Service, 2017b). Manning et al. (2008) list 33 bats that occur in Texas, Jones et al. (1973) list 44 bat species from Mexico's Yucatan Peninsula, and Placer (1998) states that at least 21 bat species are known to occur in Jamaica. Many of these bat species are included in Table 3.9-3; those that are not included are expected either to not occur in the Study Area or to occur very infrequently, while foraging on insects or crustaceans seasonally, during relatively brief periods of the summer when the air is warm, the humidity is high, the wind speed is low, and when near forested land (Ahlén et al., 2009; Bureau of Ocean Energy Management, 2013; Johnson et al., 2011; U.S. Department of Energy, 2016). Given these highly restrictive circumstances and the dispersed nature of Navy training activities, the chance that any bat species not listed in Table 3.9-3 would interact with Navy training activities is discountable.

As shown in Table 3.9-3, the range of some of the bat species within the Study Area is highly limited (e.g., to Puerto Rico), whereas the range of other bat species includes the vast portions of the Study Area. Most of these bat species are insectivorous, but some are frugivores (i.e., are fruit-eating), and one (the Mexican bulldog bat, discussed in Section 3.9.2.1.3, Dive Behavior) eats fish. In addition, some insectivorous bats are suspected to also eat crustaceans (Ahlén et al., 2009; Hatch et al., 2013).

Table 3.9-3: Bats Known or Expected to Occur in the Study Area

Bat Species		***Presence in the Study Area***		
Common Name	***Scientific Name***	***Open Ocean Areas[2]***	***Large Marine Ecosystem[2]***	***Inshore Waters***
Jamaican fruit bat[1]	*Artibeus jamaicensis*	North Atlantic Gyre	Caribbean Sea, Gulf of Mexico	
Antillean fruit-eating bat[1]	*Brachyphylla cavernarum*	North Atlantic Gyre	Caribbean Sea	
Big brown bat	*Eptesicus fuscus*	Gulf Stream, North Atlantic Gyre	Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Caribbean Sea, Gulf of Mexico	Sandy Hook Bay (Earle, NJ); Lower Chesapeake Bay (Hampton Roads, VA); Beaufort Inlet Channel (Morehead City, NC); Onslow Beach (Camp Lejeune, NC); Cape Fear River (Wilmington, NC); Seminole Beach (Jacksonville, FL); St. Andrew Bay (Panama City, FL); Sabine Lake (Beaumont, TX); Corpus Christi Bay (Corpus Christi, TX);
Brown flower bat	*Erophylla bombifrons*	None	Caribbean Sea	

Table 3.9-3: Bats Known or Expected to Occur in the Study Area (continued)

Bat Species		*Presence in the Study Area*		
Common Name	***Scientific Name***	***Open Ocean Areas[2]***	***Large Marine Ecosystem[2]***	***Inshore Waters***
Silver-haired bat[1]	*Lasionycteris noctivagans*	Gulf Stream, North Atlantic Gyre	Scotian Shelf, Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Caribbean Sea, Gulf of Mexico	Sandy Hook Bay (Earle, NJ); Lower Chesapeake Bay (Hampton Roads, VA); Beaufort Inlet Channel (Morehead City, NC); Onslow Beach (Camp Lejeune, NC); Cape Fear River (Wilmington, NC)
Eastern red bat[1]	*Lasiurus borealis*	Gulf Stream, North Atlantic Gyre	Scotian Shelf, Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Caribbean Sea, Gulf of Mexico	Sandy Hook Bay (Earle, NJ); Lower Chesapeake Bay (Hampton Roads, VA); Beaufort Inlet Channel (Morehead City, NC); Onslow Beach (Camp Lejeune, NC); Cape Fear River (Wilmington, NC); Seminole Beach (Jacksonville, FL); St. Andrew Bay (Panama City, FL); Sabine Lake (Beaumont, TX); Corpus Christi Bay (Corpus Christi, TX); Puerto Rico; U.S. Virgin Islands
Hoary bat[1]	*Lasiurus cinereus*	Labrador Current, Gulf Stream, North Atlantic Gyre	Newfoundland-Labrador Shelf, Scotian Shelf, Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Caribbean Sea, Gulf of Mexico	Sandy Hook Bay (Earle, NJ); Lower Chesapeake Bay (Hampton Roads, VA); Beaufort Inlet Channel (Morehead City, NC); Onslow Beach (Camp Lejeune, NC); Cape Fear River (Wilmington, NC); Seminole Beach (Jacksonville, FL); St. Andrew Bay (Panama City, FL); Sabine Lake (Beaumont, TX); Corpus Christi Bay (Corpus Christi, TX); Puerto Rico; U.S. Virgin Islands

Table 3.9-3: Bats Known or Expected to Occur in the Study Area (continued)

Bat Species		*Presence in the Study Area*		
Common Name	***Scientific Name***	***Open Ocean Areas***[2]	***Large Marine Ecosystem***[2]	***Inshore Waters***
Northern yellow bat	*Lasiurus intermedius*	None	Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Caribbean Sea, Gulf of Mexico	Sandy Hook Bay (Earle, NJ); Lower Chesapeake Bay (Hampton Roads, VA); Beaufort Inlet Channel (Morehead City, NC); Onslow Beach (Camp Lejeune, NC); Cape Fear River (Wilmington, NC); Seminole Beach (Jacksonville, FL); St. Andrew Bay (Panama City, FL); Sabine Lake (Beaumont, TX); Corpus Christi Bay (Corpus Christi, TX)
Minor red bat[1]	*Lasiurus minor*	None	Caribbean Sea	Puerto Rico
Seminole bat[1]	*Lasiurus seminolus*	Gulf Stream, North Atlantic Gyre	Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Caribbean Sea, Gulf of Mexico	Lower Chesapeake Bay (Hampton Roads, VA); Beaufort Inlet Channel (Morehead City, NC); Onslow Beach (Camp Lejeune, NC); Cape Fear River (Wilmington, NC); Seminole Beach (Jacksonville, FL); St. Andrew Bay (Panama City, FL); Sabine Lake (Beaumont, TX)
Pallas's mastiff bat or Pallas's free-tailed bat	*Molossus molossus*	North Atlantic Gyre	Southeast U.S. Continental Shelf, Caribbean Sea, Gulf of Mexico	
Leach's single leaf bat[1]	*Monophyllus redmani*	None	Caribbean Sea	
Antillean ghostfaced bat[1]	*Mormoops blainvillei*	None	Caribbean Sea	
Ghostfaced bat	*Mormoops megalophylla*	None	Caribbean Sea, Gulf of Mexico	Corpus Christi Bay (Corpus Christi, TX)
Southeastern myotis bat	*Myotis austroriparius*	None	Southeast U.S. Continental Shelf, Caribbean Sea, Gulf of Mexico	Onslow Beach (Camp Lejeune, NC); Cape Fear River (Wilmington, NC); Seminole Beach (Jacksonville, FL); St. Andrew Bay (Panama City, FL)
Eastern small-footed bat	*Myotis leibii*	None	Northeast U.S. Continental Shelf	Sandy Hook Bay (Earle, NJ)

Table 3.9-3: Bats Known or Expected to Occur in the Study Area (continued)

Bat Species		*Presence in the Study Area*		
Common Name	***Scientific Name***	***Open Ocean Areas[2]***	***Large Marine Ecosystem[2]***	***Inshore Waters***
Little brown bat	*Myotis lucifugus*	Gulf Stream	Newfoundland-Labrador Shelf, Scotian Shelf, Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Gulf of Mexico	Sandy Hook Bay (Earle, NJ); Lower Chesapeake Bay (Hampton Roads, VA); Seminole Beach (Jacksonville, FL); St. Andrew Bay (Panama City, FL)
Evening bat	*Nycticeius humeralis*	None	Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Caribbean Sea, Gulf of Mexico	Lower Chesapeake Bay (Hampton Roads, VA); Beaufort Inlet Channel (Morehead City, NC); Onslow Beach (Camp Lejeune, NC); Cape Fear River (Wilmington, NC); Seminole Beach (Jacksonville, FL); St. Andrew Bay (Panama City, FL); Sabine Lake (Beaumont, TX); Corpus Christi Bay (Corpus Christi, TX)
Mexican free-tailed bat	*Tadarida brasiliensis*	Gulf Stream, North Atlantic Gyre	Southeast U.S. Continental Shelf, Caribbean Sea, Gulf of Mexico	Seminole Beach (Jacksonville, FL); St. Andrew Bay (Panama City, FL); Sabine Lake (Beaumont, TX); Corpus Christi Bay (Corpus Christi, TX), Puerto Rico; U.S. Virgin Islands
Mexican bulldog bat or greater bulldog bat	*Noctilio leporinus*	None	Caribbean Sea, Gulf of Mexico	
Rafinesque's big-eared bat	*Plecotus rafinesquii*	None	Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Caribbean Sea, Gulf of Mexico	Beaufort Inlet Channel (Morehead City, NC); Onslow Beach (Camp Lejeune, NC); Cape Fear River (Wilmington, NC); Seminole Beach (Jacksonville, FL); St. Andrew Bay (Panama City, FL); Sabine Lake (Beaumont, TX)
Parnell's moustached bat	*Pteronotus parnellii*	None	Caribbean Sea	

Table 3.9-3: Bats Known or Expected to Occur in the Study Area (continued)

Bat Species		*Presence in the Study Area*		
Common Name	***Scientific Name***	***Open Ocean Areas***[2]	***Large Marine Ecosystem***[2]	***Inshore Waters***
Sooty moustached bats	*Pteronotus quadridens*	None	Caribbean Sea	
Red fruit bat	*Stenoderma rufum*	None	Caribbean Sea	

[1]Has also been reported on Bermuda during the migration season (Pelletier et al., 2013).
Bold font indicates the species migrates long distances.
Sources: (Constantine, 2003; International Union for Conservation of Nature, 2017; Placer, 1998; Tetra Tech Inc, 2016e).

In temperate North America, most species that roost in trees, such as hoary bats, migrate south for winter when insects become scarce. In the fall, hundreds of hoary bats from across the United States gather along the coasts and in northern Mexico. Mexican free-tailed bats that roost in Carlsbad Caverns during the summer also migrate to Mexico over winter (National Park Service, 2017a).

The Navy has performed bat surveys (both mist-netting and passive acoustic surveys) at several installations along the eastern coast of the United States. Results of these surveys are described below. Since echolocation calls for eastern red bats and Seminole bats are indistinguishable from each other, survey results combine these two species. In addition, it typically is not possible to identify specific species from passive acoustic survey recordings of *Myotis* species, and occasionally it is not possible to make a determination more specific than "high frequency call."

- Cutler, Maine:
  - All seven bat species expected to occur in Maine that are not federally listed are known to occur at Naval Support Activity Cutler: little brown bat, eastern small-footed bat, tri-colored bat, silver-haired bat, big brown bat, eastern red bat, and hoary bat (Tetra Tech Inc, 2014).
  - Little brown bats were the most frequently detected species and occurred across the installation at all acoustic sites during the 2013 survey. Eastern red bat was the second most common species recorded at the Installation, and occurred across all sites. Silver-haired bats and the eastern red bat are known to be active from late April through mid-October, big brown bats from late March through early October, and hoary bats from early May through early October.
  - The installation provides the local bat community with habitat from the late spring to late fall. The data also suggests that bats are utilizing habitat and traveling closer to the coast within forested and edge habitats.
  - The occurrence of migratory bat species during the summer season indicates that long-distance migratory tree-roosting bats spent the summer residency period at the installation. Data also suggests that long-distance migrants move through the installation during the fall.

- Colts Neck, New Jersey
  - Baseline bat survey at NWS Earle acoustically documented activity of eight different bat species, including big brown bat, eastern red bat, hoary bat, silver-haired bat, little

  - brown bat, eastern small-footed bat, northern long-eared bat, and tri-colored bat. Mist-net surveys further confirmed the presence of big brown bats, eastern red bat, and northern long-eared bat (Tetra Tech Inc, 2016d).

- Norfolk and Portsmouth, Virginia:
  - At Naval Station Norfolk and Naval Supply Center Craney Island Fuel Terminal at Norfolk and Portsmouth, Virginia, mist-netting surveys captured eastern red bats (*Lasiurus borealis*). Approximately 75% of acoustic detections were identified as eastern red bats/Seminole bats; the remainder were mostly designated as "high frequency" bats. Manual review of all tri-colored bat passes were determined to not contain enough detail to accurately identify to species (Tetra Tech Inc, 2017a).
- Virginia Beach, Virginia:
  - Surveys at Naval Air Station Oceana in Virginia Beach, Virginia detected nine bat species not listed under the ESA: Rafinesque's big-eared bat, big brown bat, eastern red/seminole bat, hoary bat, silver-haired bat, southeastern bat, little brown bat, evening bat, and tri-colored bat (Tetra Tech Inc, 2016c). Big brown bats were the most commonly recorded, accounting for 50 percent of the total calls, followed by silver-haired bats (24 percent), eastern red bats/Seminole bats (11 percent), hoary bats (4 percent), and *Myotis* sp. bats (4 percent). Species with 2 percent or less of the total calls were little brown bats, southeastern bats, Rafinesque's big-eared bats, evening bats, tri-colored bats, and high frequency bats.
  - Surveys at JEB Fort Story on the coast acoustically documented activity of at least ten different species of bats including Rafinesque's big-eared bat, big brown bat, eastern red/Seminole bat, hoary bat, silver-haired bat, southeastern myotis, little brown bat, northern long-eared bat, evening bat, and tri-colored bat. Eastern red bats, however, are very common and Seminole bats only occur occasionally in Virginia. The overall activity rate at JEB Fort Story was the highest detected at the four Navy bases surveyed in Virginia (Tetra Tech Inc, 2016a).

3.9.2.3.3 Migratory Birds

A variety of bird species would be encountered in the Study Area including those listed under the Migratory Bird Treaty Act (U.S. Fish and Wildlife Service, 2010d). The Migratory Bird Treaty Act established federal responsibilities for protecting nearly all migratory species of birds, eggs, and nests. Migratory bird means any bird, whatever its origin and whether or not raised in captivity, which belongs to a species listed in Section 10.13 of the Migratory Bird Treaty Act, or which is a mutation or a hybrid of any such species, including any part, nest, or egg of any such bird, or any product, whether or not manufactured, which consists, or is composed in whole or part, of any such bird or any part, nest, or egg thereof. Bird migration is defined as the periodic seasonal movement of birds from one geographic region to another, typically coinciding with available food supplies or breeding seasons. Under the Migratory Bird Treaty Act regulations applicable to military readiness activities (50 Code of Federal Regulations [CFR] Part 21), the USFWS has promulgated a rule that authorizes the incidental take of migratory birds provided they do not result in a significant impact to a population of a migratory seabird species. Of the 1,026 species protected under the Migratory Bird Treaty Act (U.S. Fish and Wildlife Service, 2013b), over 100 species occur in the Study Area. These species are not analyzed individually, but rather are grouped based on taxonomic or behavioral similarities based on the stressor that is being analyzed. Conclusions of potential impacts on species protected under the Migratory Bird Treaty Act are presented at the conclusion of each stressor subsection as well as in Section 3.9.4 (Summary of Potential Impacts on Birds).

Birds of Conservation Concern are species, subspecies, and populations of migratory birds that the USFWS determined to be the highest priority for conservation actions (U.S. Fish and Wildlife Service, 2008b). The purpose of the Birds of Conservation Concern list is to prevent or remove the need for additional ESA bird listings by implementing proactive management and conservation actions needed to conserve these species. Of the species that occur within the Study Area, 62 are considered Birds of Conservation Concern (Table 3.9-4). With the exception of the black-capped petrel, a species that is under review and could be proposed for listing under the ESA in the near future (see below), and the bald eagle, these species are not analyzed individually, but rather are grouped by taxonomic or behavioral similarities based on the stressor being analyzed.

Table 3.9-4: Birds of Conservation Concern that Occur within the Study Area

Order/Family	***Common Name***	***Scientific Name***
Order Gaviiformes		
Family Gaviidae		
	Common loon	*Gavia immer*
	Red-throated loon	*Gavia stellata*
Order Podicipediformes		
Family Podicipedidae		
	Horned grebe	*Podiceps auritus*
	Pied billed grebe	*Podilymbus podiceps*
Order Procellariiformes		
Family Procellariidae		
	Audubon's shearwater	*Puffinus lherminieri*
	Black-capped petrel	*Pterodroma hasitata*
	Greater shearwater	*Puffinus gravis*
Family Hydrobatidae		
	Band-rumped storm petrel	*Oceanodroma castro*
Order Sulifromes		
Family Sulidae		
	Brown booby	*Sula leucogaster*
	Masked booby	*Sula dactylatra*
Family Phalacrocoracidae		
	Great cormorant	*Phalacrocorax carbo*
Family Frigatidae		
	Magnificent frigatebird	*Fregata magnificens*
Order Pelecaniformes		
Family Threskiornithidae		
	Roseate spoonbill	*Platalea ajaja*
Family Ardeidae		

Table 3.9-4: Birds of Conservation Concern that Occur within the Study Area (continued)

Order/Family	*Common Name*	*Scientific Name*
	Reddish egret	*Egretta rufescens*
	Snowy egret	*Egretta thula*
	American bittern	*Botarus lentiginous*
	Least bittern	*Ixobrychus exilis*
Order Falconiformes		
Family Falconidae		
Family Haematopodidae		
	American oystercatcher	*Haematopus palliatus*
Family Scolopacidae		
Subfamily Scolopacinae	Bar-tailed godwit	*Limosa lapponica*
	Dunlin	*Calidris alpina*
	Hudsonian godwit	*Limosa haemastica*
	Lesser yellowlegs	*Tringa flavipes*
	Marbled godwit	*Limosa fedoa*
	Purple sandpiper	*Calidris maritima*
	Red knot	*Calidris canutus*
	Semipalmated sandpiper	*Calidris pusilla*
	Short-billed dowitcher	*Limnodromus griseus*
	Solitary sandpiper	*Tringa solitaria*
	Whimbrel	*Numenius phaeopus*
Family Laridae		
Subfamily Rynchopinae	Black skimmer	*Rynchops niger*
Subfamily Sterninae	Arctic tern	*Sterna paradisaea*
	Gull-billed tern	*Gelochelidon nilotica*
	Least tern	*Sternula antillarum*
	Sandwich tern	*Thalasseus sandvicensis*
Order Passeriformes		
Family Emberizidae		
	Saltmarsh sparrow	*Ammodramus caudacutus*
	Seaside sparrow	*Ammodramus maritimus*
Family Tyrannidae		
	Olive-sided flycatcher	*Contopus cooperi*
Family Turdidae		
	Bicknell's thrush	*Catharus bicknelli*
	Wood thrush	*Hylocichla mustelina*
Family Parulidae		
	Bay-breasted warbler	*Dendroica castanea*
	Blue-winged warbler	*Vermivora pinus*
	Canada warbler	*Wilsonia canadensis*
	Cerulean warbler	*Dendroica cerulea*
	Golden-winged warbler	*Vermivora chrysoptera*
	Kentucky warbler	*Oporornis formosus*
	Prairie warbler	*Dendroica discolor*
	Prothonotary warbler	*Protonotaria citrea*
	Swainson's warbler	*Limnothlypis swainsonii*
	Worm-eating warbler	*Helmitheros vermivorum*

Table 3.9-4: Birds of Conservation Concern that Occur within the Study Area (continued)

Order/Family	***Common Name***	***Scientific Name***
Family Cardinalidae		
	Dickcissel	*Spiza americana*
	Painted bunting	*Passerina ciris*
Order Cuculiformes		
Family Cuculidae		
	Mangrove cuckoo	*Coccyzus minor*
	Yellow-billed cuckoo	*Coccyzus americanus*
Order Strigiformes		
Family Strigiformes		
	Short-eared owl	*Asio flammeus*
Order Apodiformes		
Family Apodidae		
	Black swift	*Cypseloides niger*

3.9.3 Environmental Consequences

This section evaluates how and to what degree the activities described in Chapter 2 (Description of Proposed Action and Alternatives) potentially impact birds or bats known to occur within the Study Area. Tables 2.3-1 through 2.3-5 present the baseline and proposed typical training and testing activity locations for each alternative (including number of events). General characteristics of all Navy stressors were introduced in Section 3.0.3.3 (Identifying Stressors for Analysis), and living resources' general susceptibilities to stressors were introduced in Section 3.0.3.6 (Biological Resource Methods). The stressors vary in intensity, frequency, duration, and location within the Study Area. The stressors analyzed for birds and bats are:

- **Acoustics** (sonar and other transducers; air guns; pile driving; aircraft noise; vessel noise; and weapons noise);
- **Explosives** (explosions in-air, explosions in-water);
- **Energy** (in-water electromagnetic devices, in-air electromagnetic devices; and high energy lasers);
- **Physical disturbance and strikes** (vessels & in-water devices, aircraft & aerial targets, military expended materials, seafloor devices);
- **Entanglement** (wires and cables; decelerators/parachutes; biodegradable polymers);
- **Ingestion** (military expended materials – munitions, military expended materials - other than munitions); and
- **Secondary stressors** (impacts to habitat, impacts to prey availability).

Each of these components is analyzed for potential impacts on birds and bats within the stressor categories contained in this section. The specific analysis of the training and testing activities considers these components within the context of geographic location and overlap of marine bird resources and bat occurrence. In addition to the analysis here, the details of all training and testing activities, stressors, components that cause the stressor, and geographic overlap within the Study Area are summarized in Section 3.0.3.3 (Identifying Stressors for Analysis) and detailed in Appendix B (Activity Stressor Matrices).

3.9.3.1 Acoustic Stressors

This section evaluates the potential for acoustic stressors to impact birds and bats during training and testing activities in the Study Area. Assessing whether sounds may disturb or injure an animal involves understanding the characteristics of the acoustic sources, the animals that may be present in the vicinity of the sound, and the effects that sound may have on the physiology and behavior of those animals. Impacts could depend on other factors besides the received level of sound, such as the animal's physical condition, prior experience with the sound, and proximity to the source of the sound.

The below analysis of effects to birds and bats follows the concepts outlined in Section 3.0.3.6.1 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities). This section begins with a summary of relevant data regarding acoustic impacts to birds and bats in Section 3.9.3.1.1 (Background). This is followed by an analysis of impacts to birds and bats due to specific Navy acoustic stressors (sonar and other transducers; air guns; pile driving; vessel noise; aircraft noise; and weapons noise). Additional explanation of the acoustic terms and sound energy concepts used in this section is found in Appendix D (Acoustic and Explosive Concepts).

3.9.3.1.1 Background

The sections below include a survey and synthesis of best-available-science published in peer-reviewed journals, technical reports, and other scientific sources pertinent to impacts to birds and bats potentially resulting from sound-producing Navy training and testing activities. Impacts to birds and bats depend on the sound source and context of exposure. Possible impacts include auditory or non-auditory trauma, hearing loss resulting in temporary or permanent hearing threshold shift, auditory masking, physiological stress, or changes in behavior, including changing habitat use and activity patterns, increasing stress response, decreasing immune response, reducing reproductive success, increasing predation risk, and degrading communication, (Larkin et al., 1996). Numerous studies have documented that birds and other wild animals respond to human-made noise (Bowles et al., 1994; Larkin et al., 1996; National Park Service, 1994). The manner in which birds or bats respond to noise could depend on species physiology, life stage, characteristics of the noise source, loudness, onset rate, distance from the noise source, presence/absence of associated visual stimuli, and previous exposure. Noise may cause physiological or behavioral responses that reduce the animals' fitness or ability to grow, survive, and reproduce successfully.

The types of birds and bats exposed to sound-producing activities depend on where training and testing activities occur. Birds in the Study Area can be divided into three groups based on breeding and foraging habitat: (1) those species such as albatrosses, petrels, frigatebirds, tropicbirds, boobies, alcids, and some terns that forage over the ocean and nest on oceanic islands; (2) species such as pelicans, cormorants, gulls, and some terns that nest along the coast and forage in nearshore areas; and (3) those few species such as skuas, jaegers, Franklin's gull, Bonaparte's gulls, ring-billed gulls, black terns, and ducks and loons that nest and forage in inland habitats and come to the coastal areas during nonbreeding seasons. In addition, birds that are typically found inland, such as songbirds, may be present flying in large numbers over open ocean areas (particularly over the Gulf of Mexico) during annual spring and fall migration periods. Bats in the Study Area that have the potential to be exposed to sound-producing activities from training and testing would be those that occur in coastal or offshore waters, or those that migrate over open ocean areas.

Birds and bats could be exposed to sounds from a variety of sources. While above the water surface, birds and bats may be exposed to airborne sources such as pile driving, weapons noise, vessel noise, and aircraft noise. While foraging and diving, birds may be exposed to underwater sources such as sonar, pile driving, air guns, and vessel noise. In addition, bats are typically nocturnal and would likely be exposed only to sources of noise from activities that occur between dusk and dawn. While foraging birds will be present near the water surface, migrating birds may fly at various altitudes. Some species such as sea ducks and loons may be commonly seen flying just above the water's surface, but the same species can also be spotted flying high enough (5800 ft.) that they are barely visible through binoculars (Lincoln et al., 1998). While there is considerable variation, the favored altitude for most small birds appears to be between 500 ft. (152 m) and 1,000 ft. (305 m). Radar studies have demonstrated that 95 percent of the migratory movements occur at less than 10,000 ft. (3,050 m), with the bulk of the movements occurring under 3,000 ft. (914 m) (Lincoln et al., 1998). While several studies have shown that bats typically fly lower than 10 m above sea level (Ahlén et al., 2009; Pelletier et al., 2013), others have shown that migrating bats have been observed over 200 m above sea level (Hatch et al., 2013; Sjollema et al., 2014).

Seabirds use a variety of foraging behaviors that could expose them to underwater sound. Most seabirds plunge-dive from the air into the water or perform aerial dipping (the act of taking food from the water surface in flight); others surface-dip (swimming and then dipping to pick up items below the surface) or jump-plunge (swimming, then jumping upward and diving underwater). Birds that feed at the surface by surface or aerial dipping with limited to no underwater exposure include petrels, jaegers, and phalaropes. Birds that plunge-dive are typically submerged for short durations, and any exposure to underwater sound would be very brief. Birds that plunge-dive include albatrosses, some tern species, masked boobies, gannets, shearwaters, and tropicbirds. Some birds, such as cormorants, seaducks, alcids, and loons pursue prey under the surface, swimming deeper and staying underwater longer than other plunge-divers. Some of these birds may stay underwater for up to several minutes and reach depths between 50 ft. (15 m) and 550 ft. (168 m) (Alderfer, 2003; Durant et al., 2003; Jones, 2001; Lin, 2002; Ronconi, 2001). Birds that forage near the surface would be exposed to underwater sound for shorter periods of time than those that forage below the surface. Exposures of birds that forage below the surface may be reduced by destructive interference of reflected sound waves near the water surface (see Appendix D, Acoustic and Explosive Concepts). Sounds generated underwater during training and testing would be more likely to impact birds that pursue prey under the surface, although as previously stated, little is known about seabird hearing ability underwater.

3.9.3.1.1.1 Injury

Auditory structures can be susceptible to direct mechanical injury due to high levels of impulsive sound. This could include tympanic membrane rupture, disarticulation of the middle ear ossicles, and trauma to the inner ear structures such as the hair cells within the organ of Corti. Auditory trauma differs from auditory fatigue in that the latter involves the overstimulation of the auditory system, rather than direct mechanical damage, which may result in hearing loss (see Section 3.9.3.1.1.2, Hearing Loss). There are no data on damage to the middle ear structures of birds due to acoustic exposures. Because birds are known to regenerate auditory hair cells, studies have been conducted to purposely expose birds to very high sound exposure levels (SELs) in order to induce hair cell damage in the inner ear. Because damage can co-occur with fatiguing exposures at high SELs, effects to hair cells are discussed below in Section 3.9.3.1.1.2 (Hearing Loss).

Because there is no data on non-auditory injury to birds from intense non-explosive sound sources, it may be useful to consider information for other similar-sized vertebrates. The rapid large pressure change near non-explosive impulsive underwater sound sources, such as some large air guns and pile driving, are thought to be potentially injurious to other small animals (fishes and sea turtles). While long duration exposures (i.e., minutes to hours) to high sound levels of sonars are thought to be injurious to fishes, this has not been experimentally observed [see Popper et al. (2014)]. Potential for injury is generally attributed to compression and expansion of body gas cavities, either due to rapid onset of pressure changes or resonance (enhanced oscillation of a cavity at its natural frequency). Because water is considered incompressible and animal tissue is generally of similar density as water, animals would be more susceptible to injury from a high-amplitude sound source in water than in air since waves would pass directly through the body rather than being reflected. Proximal exposures to high-amplitude non-impulsive sounds underwater could be limited by a bird's surfacing response.

In air, the risk of barotrauma would be associated with high-amplitude impulses, such as from explosives (discussed in Section 3.9.3.2, Explosive Stressors). Unlike in water, most acoustic energy will reflect off the surface of an animal's body in air. Plus, air is compressible whereas water is not, allowing energy to dissipate more rapidly. For these reasons, in-air non-explosive sound sources in this analysis are considered to pose little risk of non-auditory injury.

Limited data exists on instances of barotrauma to bats. The data that does exist has investigated the hypothesis of rapid pressure changes due to rotating wind turbine blades (Baerwald et al., 2008; Rollins et al., 2012). Bats in these situations have been shown to have ruptured tympana. Although it is undetermined if these ruptures were due to pressure changes or to direct strike, the potential exists for auditory injury as a result of high-amplitude sound exposure.

3.9.3.1.1.2 Hearing Loss

Exposure to intense sound may result in hearing loss which persists after cessation of the noise exposure. Hearing loss may be temporary or permanent, depending on factors such as the exposure frequency, received sound pressure level (SPL), temporal pattern, and duration. Hearing loss could impair a bird's or a bat's ability to hear biologically important sounds within the affected frequency range. Biologically important sounds come from social groups, potential mates, offspring, or parents; environmental sounds, prey, and predators.

Because in-air measures of hearing loss and recovery in birds due to an acoustic exposure are limited [e.g., quail, budgerigars, canaries, and zebra finches (Ryals et al., 1999); budgerigar (Hashino et al., 1988); parakeet (Saunders & Dooling, 1974); quail (Niemiec et al., 1994)] and no studies exist of bird hearing loss due to underwater sound exposures, auditory threshold shift in birds is considered to be consistent with general knowledge about noise-induced hearing loss described in the Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities (see Section 3.0.3.6.1). The frequencies affected by hearing loss would vary depending on the exposure frequency. The limited data on hearing loss in birds shows that the frequency of exposure is the hearing frequency most likely to be affected (Saunders & Dooling, 1974).

Hearing loss can be due to biochemical (fatiguing) processes or tissue damage. Tissue damage can include damage to the auditory hair cells and their underlying support cells. Hair cell damage has been observed in birds exposed to long-duration sounds that resulted in initial threshold shifts greater than 40 dB (Niemiec et al., 1994; Ryals et al., 1999). Unlike many other animals, birds have the ability to regenerate hair cells in the ear, usually resulting in considerable anatomical, physiological, and behavioral recovery within several weeks (Rubel et al., 2013; Ryals et al., 1999). Still, intense exposures are not always fully recoverable, even over periods up to a year after exposure, and damage and subsequent recovery vary significantly by species (Ryals et al., 1999). Birds may be able to protect themselves against damage from sustained sound exposures by reducing middle ear pressure, an ability that may protect ears while in flight (Ryals et al., 1999) and from injury due to pressure changes during diving (Dooling & Therrien, 2012).

Hearing loss is typically quantified in terms of threshold shift—the amount (in dB) that hearing thresholds at one or more specified frequencies are elevated, compared to their pre-exposure values, at some specific time after the noise exposure. The amount of threshold shift measured usually decreases with increasing recovery time—the amount of time that has elapsed since a noise exposure. If the threshold shift eventually returns to zero (i.e., the hearing threshold returns to the pre-exposure value), the threshold shift is called a temporary threshold shift (TTS). If the threshold shift does not completely recover (the threshold remains elevated compared to the pre-exposure value), the remaining threshold shift is called a permanent threshold shift (PTS). By definition, TTS is a function of the recovery time, therefore comparing the severity of noise exposures based on the amount of induced TTS can only be done if the recovery times are also considered. For example, a 20-dB TTS measured 24-h post-exposure indicates a more hazardous exposure than one producing 20 dB of TTS measured only 2 min after exposure; if the TTS is 20 dB after 24 h, the TTS measured after 2 min would have likely been much higher. Conversely, if 20 dB of TTS was measured after 2 min, the TTS measured after 24 h would likely have been much smaller.

Studies in mammals have revealed that noise exposures resulting in high levels of TTS (greater than 40 dB) may also result in neural injury without any permanent hearing loss (Kujawa & Liberman, 2009; Lin et al., 2011). It is unknown if a similar effect would be observed for birds.

Hearing Loss due to Non-Impulsive Sounds

Birds

Behavioral studies of threshold shift in birds within their frequencies of best hearing (between 2 and 4 kHz) due to long-duration (30 minutes to 72 hours) continuous, non-impulsive, high-level sound exposures in air have shown that susceptibility to hearing loss varies substantially by species, even in species with similar auditory sensitivities, hearing ranges, and body size (Niemiec et al., 1994; Ryals et al., 1999; Saunders & Dooling, 1974). For example, Ryals et al. (1999) conducted the same exposure experiment on quail and budgerigars, which have very similar audiograms. A 12-hour exposure to a 2.86 kHz tone at 112 dB re 20 µPa SPL [cumulative SEL of 158 dB re 20 $\mu Pa^2 s$] resulted in a 70 dB threshold shift measured after 24 hours of recovery in quail, but a substantially lower 40 dB threshold shift measured after just 12 hours of recovery in budgerigars which recovered to within 10 dB of baseline after three days and fully recovered by one month (Ryals et al., 1999). Although not directly comparable, this SPL would be perceived as extremely loud but just under the threshold of pain for humans per the American Speech-Language-Hearing Association. Whereas the 158 dB re 20 μPa^2-s SEL tonal exposure to quail discussed above caused 20 dB of PTS (Ryals et al., 1999), a shorter (4-hour) tonal exposure to quail with similar SEL (157 dB re 20 μPa^2-s) caused 65 dB of threshold shift that fully recovered within two weeks (Niemiec et al., 1994).

Data on threshold shift in birds due to relatively short-duration sound exposures that could be used to estimate the onset of threshold shift is limited. Saunders and Dooling (1974) provide the only threshold shift growth data measured for birds. Saunders and Dooling (1974) exposed young budgerigars to four levels of continuous 1/3-octave band noise (76, 86, 96, and 106 dB re 20 µPa) centered at 2.0 kHz and measured the threshold shift at various time intervals during the 72-hour exposure. The earliest measurement found 7 dB of threshold shift after approximately 20 minutes of exposure to the 96 dB re

20 µPa SPL noise (127 dB re 20 µPa^2-s SEL). Generally, onset of TTS in other species has been considered 6 dB above measured threshold (Finneran, 2015), which accounts for natural variability in auditory thresholds. The Saunders and Dooling (1974) budgerigar data is the only bird data showing low levels of threshold shift. Because of the observed variability of threshold shift susceptibility among bird species and the relatively long duration of sound exposure in Saunders and Dooling (1974), the observed onset level cannot be assumed to represent the SEL that would cause onset of TTS for other bird species or for shorter-duration exposures (i.e., a higher SEL may be required to induce TTS for shorter-duration exposures).

Since the goal of most bird hearing studies has been to induce hair cell damage to study regeneration and recovery, exposure durations were purposely long. Studies with other non-avian species have shown that long-duration exposures tend to produce more threshold shift than short-duration exposures with the same SEL [e.g., see Finneran (2015)]. The SELs that induced TTS and PTS in these studies likely over-estimate the potential for hearing loss due to any short-duration sound of comparable SEL that a bird could encounter outside of a controlled laboratory setting. In addition, these studies were not designed to determine the exposure levels associated with the onset of any threshold shift or to determine the lowest SEL that may result in PTS.

With insufficient data to determine PTS onset for birds due to a non-impulsive exposure, data from other taxa are considered. Studies of terrestrial mammals suggest that 40 dB of threshold shift is a reasonable estimate of where PTS onset may begin [see (Southall et al., 2009)]. Similar amounts of threshold shift has been observed in some bird studies with no subsequent PTS. Of the birds studied, the budgerigars showed intermediate susceptibility to threshold shift; the budgerigars exhibited threshold shifts in the range of 40 dB to 50 dB after 12-hour exposures to 112 dB and 118 dB re 20 µPa SPL tones at 2.86 kHz (158 – 164 dB re 20 µPa^2-s SEL), which recovered to within 10 dB of baseline after three days and fully recovered by one month (Ryals et al., 1999). These experimental SELs are a conservative estimate of the SEL above which PTS may be considered possible for birds.

All of the above studies were conducted in air. There are no studies of hearing loss to diving birds due to underwater exposures.

Bats

Bats exposed to loud noise have not been shown to exhibit TTS (Hom et al., 2016; Simmons et al., 2015; Simmons et al., 2016). Recently, Hom et al. (2016) exposed four big brown bats (*Eptesicus fuscus*) to intense broadband noise (10—100 kHz with SEL 152 dB re 20 µPa^2-s over 1 hour) and found no effect on the bats' vocalizations (which could indicate a change in hearing) or psychophysical thresholds 20 minutes, 24 hours, or 48 hours after exposure (Hom et al., 2016; Simmons et al., 2016). Another study on the Japanese house bat (*Pipistrellus abramus*) measured physiological (auditory brainstem response) thresholds immediately after a noise exposure (10—80 kHz, 90 dB re 20 µPa SPL, 30 minute duration) and also did not find evidence of TTS (Simmons et al., 2015). This may be because bats are adapted to hear in an acoustic environment where they are likely to experience loud sounds (110-140 dB re 20 µPa SPL) continuously for several hours while hunting near other bats that are also echolocating (Jakobsen et al., 2013; Simmons et al., 2001). It is also possible that the stimuli used in these experiments were not loud enough to induce TTS or that measurements of hearing sensitivity took place outside the time window where TTS might be observed.

Hearing Loss due to Impulsive Sounds

The only measure of hearing loss in a bird due to an impulsive noise exposure was conducted by Hashino et al. (1988), in which budgerigars were exposed to the firing of a pistol with a received level of 169 dB re 20 µPa peak SPL (two gunshots per each ear); SELs were not provided. While the gunshot frequency power spectrum had its peak at 2.8 kHz, threshold shift was most extensive below 1 kHz. Threshold shift recovered at frequencies above 1 kHz, while a 24 dB PTS was sustained at frequencies below 1 kHz. Studies of hearing loss in diving birds exposed to impulsive sounds underwater do not exist.

Because there is only one study of hearing loss in birds due to an impulsive exposure and no studies of hearing loss in bats due to an impulsive exposure, the few studies of hearing loss in birds and bats due to exposures to non-impulsive sound are the only other data upon which to assess bird and bat susceptibility to hearing loss from an impulsive sound source. Data from other taxa (U.S. Department of the Navy, 2017) indicate that, for the same SEL, impulsive exposures are more likely to result in hearing loss than non-impulsive exposures. This is due to the high peak pressures and rapid pressure rise times associated with impulsive exposures.

3.9.3.1.1.3 Masking

Masking occurs when one sound, distinguished as the 'noise,' interferes with the detection or recognition of another sound. The quantitative definition of masking is the amount in decibels an auditory detection or discrimination threshold is raised in the presence of a masker (Erbe et al., 2016). As discussed in Section 3.0.3.6.1 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Stressors), masking can effectively limit the distance over which an animal can communicate and detect biologically relevant sounds. Masking only occurs in the presence of the masking noise and does not persist after the cessation of the noise.

Birds

Critical ratios are the lowest ratio of signal-to-noise at which a signal can be detected. When expressed in decibels, critical ratios can easily be calculated by subtracting the noise level (in dB re 1 μPa^2 /Hz) from the signal level (in dB re 1 µPa) at detection threshold. A signal must be received above the critical ratio at a given frequency to be detectable by an animal. Critical ratios have been determined for a variety of bird species [e.g., Dooling (1980), Noirot et al. (2011), Dooling and Popper (2000), and Crowell (2016)] and inter-species variability is evident. Some birds exhibit low critical ratios at certain vocal frequencies, perhaps indicating that hearing evolved to detect signals in noisy environments or over long distances (Dooling & Popper, 2000).

The effect of masking is to limit the distance over which a signal can be perceived. An animal may attempt to compensate in several ways, such as by increasing the source level of vocalizations (the Lombard effect), changing the frequency of vocalizations, or changing behavior (e.g., moving to another location, increase visual display). Birds have been shown to shift song frequencies in the presence of a tone at a similar frequency (Goodwin & Podos, 2013), and in continuously noisy urban habitats, populations have been shown to have altered song duration and shift to higher frequencies (Slabbekoorn & den Boer-Visser, 2006). Changes in vocalization may incur energetic costs and hinder communication with conspecifics, which, for example, could result in reduced mating opportunities. These effects are of long-term concern in constant noisy urban environments (Patricelli & Blickley, 2006) where masking conditions are prevalent.

Bats

Bats can experience masking during echolocation and communication from a variety of sources such as other bats and jamming of their echolocation signal by prey species (Bates et al., 2011; Chiu et al., 2008; Conner & Corcoran, 2012; Corcoran et al., 2009; Griffin et al., 1962; Simmons et al., 1988; Ulanovsky et al., 2004). They have many strategies to compensate for masking, such as dynamically changing the duration, spectrum, aim, and pattern of their echolocation (Bates et al., 2011; Moss et al., 2011; Petrites et al., 2009; Simmons et al., 2001; Wheeler et al., 2016).

Like other animals, bats increase the amplitude of their vocalizations in response to an increase in background noise level, which is known as the Lombard effect (Hage et al., 2013). It is estimated that a broadband signal of 65 dB re 20 µPa SPL would begin masking most bats' echolocation from targets beyond 1.5 m away (Arnett et al., 2013). Bats have been shown to shift the frequency of their calls when a stimulus was within 2-3 kHz of their preferred frequency (Bates et al., 2008).

Behavioral and psychophysical experiments show that the flexibility of bat vocalizations allows for perceptual rejection of masking due to clutter in the surroundings (Bates et al., 2011; Hiryu et al., 2010; Warnecke et al., 2015) or other sources of noise (Bates et al., 2008; Miller et al., 2004; Ulanovsky et al., 2004).

Overall, bats seem to avoid areas with high levels of noise – especially when the noise frequency spectrum overlaps with frequencies important for hunting (20-90 kHz). In a controlled laboratory experiment, Schaub et al. (2008) found that, when given a choice, bats spent 10% less time foraging in the compartment with noise (traffic, wind, and broadband white noise) as compared to the silent control chamber. Additionally, hunting in the noisy compartment yielded 10% fewer successful prey interceptions. Bats spent significantly less time, and were significantly less successful as noise conditions increased in bandwidth and overall exposure levels. The greater the noise overlap with frequencies being attended to by the bat, the greater the disturbance to the bats' foraging behavior. However, this experiment was conducted on a small spatial scale, and with the absence of other sensory cues (light). Although laboratory research has shown that noise can decrease hunting success (Siemers & Schaub, 2011), and field and laboratory studies show that foraging bats avoid noise (Berthinussen & Altringham, 2012; Schaub et al., 2008), no studies provide direct evidence from playback experiments in the field that commuting or migrating bats are disturbed by sound.

3.9.3.1.1.4 Physiological Stress

Animals in the marine environment naturally experience stressors within their environment and as part of their life histories. Changing weather and ocean conditions, exposure to diseases and naturally occurring toxins, lack of prey availability, social interactions with members of the same species, nesting, and interactions with predators all contribute to stress. Anthropogenic sound-producing activities have the potential to provide additional stressors beyond those that naturally occur, as described in Section 3.0.3.6.1 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Stressors).

Chronic stress due to disturbance may compromise the general health and reproductive success of birds (Kight et al., 2012), but a physiological stress response is not necessarily indicative of negative consequences to individual birds or to populations (Larkin et al., 1996; National Park Service, 1994). The reported behavioral and physiological responses of birds to noise exposure can fall within the range of normal adaptive responses to external stimuli, such as predation, that birds face on a regular basis. These responses can include activation of the neural and endocrine systems, causing changes such as increased blood pressure, available glucose, and blood levels of corticosteroids (Manci et al., 1988). It is possible that individuals would return to normal almost immediately after short-term or transient exposure, and the individual's metabolism and energy budget would not be affected in the long-term. Studies have also shown that birds can habituate to noise following frequent exposure and cease to respond behaviorally to the noise (Larkin et al., 1996; National Park Service, 1994; Plumpton, 2006). However, the likelihood of habituation is dependent upon a number of factors, including species of bird (Bowles et al., 1991), and frequency of and proximity to exposure. Although Andersen et al. (1990) did not evaluate noise specifically, they found evidence that anthropogenic disturbance is related to changes in home ranges; for example, raptors have been shown to shift their terrestrial home range when concentrated military training activity was introduced to the area. On the other hand, cardinals nesting in areas with high levels of military training activity (including gunfire, artillery, and explosives) were observed to have similar reproductive success and stress hormone levels as cardinals in areas of low activity (Barron et al., 2012).

While physiological responses such as increased heart rate or startle response can be difficult to measure in the field, they often accompany more easily measured reactions like behavioral responses. A startle is a reflex characterized by rapid increase in heart rate, shutdown of nonessential functions, and mobilization of glucose reserves. Habituation keeps animals from expending energy and attention on harmless stimuli, but the physiological component might not habituate completely (Bowles, 1995).

A strong and consistent behavioral or physiological response is not necessarily indicative of negative consequences to individuals or to populations (Bowles, 1995; Larkin et al., 1996; National Park Service, 1994). For example, many of the reported behavioral and physiological responses to noise are within the range of normal adaptive responses to external stimuli, such as predation, that wild animals face on a regular basis. In many cases, individuals would return to homeostasis or a stable equilibrium almost immediately after exposure. The individual’s overall metabolism and energy budgets would not be affected if it had time to recover before being exposed again. If the individual does not recover before being exposed again, physiological responses could be cumulative and lead to reduced fitness. However, it is also possible that an individual would have an avoidance reaction (i.e., move away from the noise source) to repeated exposure or habituate to the noise when repeatedly exposed.

Due to the limited information about acoustically induced stress responses, the Navy conservatively assumes in its effects analysis that any physiological response (e.g., hearing loss or injury) or significant behavioral response is also associated with a stress response.

3.9.3.1.1.5 Behavioral Reactions

Numerous studies have documented that birds and other wild animals respond to human-made noise, including aircraft overflights, weapons firing, and explosions (Larkin et al., 1996; National Park Service, 1994; Plumpton, 2006). The manner in which an animal responds to noise could depend on several factors, including life history characteristics of the species, characteristics of the noise source, sound source intensity, onset rate, distance from the noise source, presence or absence of associated visual stimuli, food and habitat availability, and previous exposure (see Section 3.0.3.6.1, Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities). Researchers have documented a range of bird behavioral responses to noise, including no response, head turn, alert behavior, startle response, flying or swimming away, diving into the water, and increased vocalizations (Brown et al., 1999; Larkin et al., 1996; National Park Service, 1994; Plumpton, 2006; Pytte et al., 2003; Stalmaster & Kaiser, 1997). Bat behavioral studies have shown reactions in response to acoustic interference such as reduced activity, area avoidance, and modifying the duration or frequency of calls (Arnett et al., 2013;

Bates et al., 2008; Baxter et al., 2006). Some behavioral responses may be accompanied by physiological responses, such as increased heart rate or short-term changes in stress hormone levels (Partecke et al., 2006).

Behavioral responses may depend on the characteristics of the noise, and whether the noise is similar to biologically relevant sounds, such as alarm calls by other birds and predator sounds. For example, European starlings (*Sturnus vulgaris*) took significantly longer to habituate to repeated bird distress calls than white noise or pure tones (Johnson et al., 1985). Starlings may have been more likely to continue to respond to the distress because it is a more biologically meaningful sound. Starlings were also more likely to habituate in winter than summer, possibly meaning that food scarcity or seasonal physiological conditions may affect intensity of behavioral response (Johnson et al., 1985).

Behavioral Reactions to Impulsive Sound Sources

Studies regarding behavioral responses by non-nesting birds to impulsive sound sources are limited. Seismic surveys had no noticeable impacts on the movements or diving behavior of long-tailed ducks undergoing wing molt, a period in which flight is limited and food requirements are high (Lacroix et al., 2003). The birds may have tolerated the seismic survey noise to stay in preferred feeding areas.

Responses to aircraft sonic booms are informative of responses to single impulsive sounds. Responses to sonic booms are discussed below in Behavioral Reactions to Aircraft.

Behavioral Reactions to Sonar and other Active Acoustic Sources

There are no studies of bird responses underwater to sonars, but the effect of pingers on fishing nets has been examined. Fewer common murres (*Uria aalge*) were entangled in gillnets when the gillnets were outfitted with 1.5 kHz pingers with a source level of 120 dB re 1 µPa; however, there was no significant reduction in rhinoceros auklet (*Cerorhinca monocerata*) bycatch in the same nets (Melvin et al., 1999; Melvin et al., 2011). It was unknown whether the pingers elicited a behavioral response by the birds, or decreased prey availability.

Behavioral Responses to Aircraft

There are multiple possible of the factors involved in behavioral responses to aircraft overflights, including the noise stimulus as well as the visual stimulus.

Observations of tern colonies responses to balloon overflights suggest that visual stimulus is likely to be an important component of disturbance from overflights (Brown, 1990). Although it was assumed nesting colonial waterbirds may be more likely to flush or exhibit a mob response when disturbed, observations of nesting black skimmers and nesting least, gull-billed, and common terns showed they did not modify nesting behavior in response to military fixed-wing aircraft engaged in low-altitude tactical flights and rotary-wing overflights (Hillman et al., 2015). Maximum behavioral responses by crested tern (*Sterna bergii*) to aircraft noise were observed at sound level exposures greater than 85 dBA re 20 µPa. However, herring gulls (*Larus argentatus*) significantly increased their aggressive interactions within the colony and their flights over the colony during overflights with received SPLs of 101–116 dBA re 20 µPa (Burger, 1981).

Raptors and wading birds have responded minimally to jet (110 dBA re 20 µPa) and propeller plane (92 dBA re 20 µPa) overflights, respectively (Ellis, 1981). Jet flights greater than 1,640 ft. (500 m) distance from raptors were observed to elicit no response (Ellis, 1981). The impacts of low-altitude military training flights on wading bird colonies in Florida were estimated using colony distributions and turnover rates. There were no demonstrated impacts of military activity on wading bird colony establishment or size (Black et al., 1984). Fixed-winged jet aircraft disturbance did not seem to adversely affect waterfowl observed during a study in coastal North Carolina (Conomy et al., 1998); however, harlequin ducks were observed to show increased agonistic behavior and reduced courtship behavior up to one to two hours after low-altitude military jet overflights (Goudie & Jones, 2004).

It is possible that birds could habituate and no longer exhibit behavioral responses to aircraft noise, as has been documented for some impulsive noise sources (Ellis, 1981; Russel et al., 1996) and aircraft noise (Conomy et al., 1998). Ellis (1981) found that raptors would typically exhibit a minor short-term startle response to simulated sonic booms, and no long-term effect to productivity was noted.

Near-total failure of sooty tern nesting in the Dry Tortugas in the Key West Range Complex was reported in 1969 during a period when the birds were regularly exposed to sonic booms (Austin et al., 1970). In previous seasons, the birds were reported to react to the occasional sonic booms by rising immediately in a "panic flight," circling over the island, and then usually settling down on their eggs again. Researchers had no evidence that sonic booms caused physical damage to the sooty tern eggs, but hypothesized that the strong booms occurred often enough to disturb the sooty terns' incubating rhythm and cause nest desertion. The 1969 sooty tern nesting failure also prompted additional research to test the hypothesis that sonic booms could cause bird eggs to crack or otherwise affect bird eggs or embryos. However, the findings of the additional research determined that aircraft overflight and sonic booms were not a cause of the failure, and neither were panic flights, predators, weather, inadequate food supplies, or tick infestation (Bowles et al., 1991; Bowles et al., 1994; Teer & Truett, 1973; Ting et al., 2002). That same year, the colony also contained approximately 2,500 brown noddies, whose young hatched successfully. While it was impossible to conclusively determine the cause of the 1969 sooty tern nesting failure, actions were taken to curb planes breaking the sound barrier within range of the Tortugas, and much of the excess vegetation was cleared (another hypothesized contributing factor to the nesting failure). Similar nesting failures have not been reported since the 1969 failure.

As described in Section 5.3.2.5 (Aircraft Overflight Noise), the Navy implements mitigation within the Tortugas Military Operations Area, which is a unique block of special use airspace above the Dry Tortugas National Park that has special flight rules designed to minimize military aircraft noise. Mitigation includes not conducting combat maneuver flights below 5,000-ft. or tactical maneuvers resulting in supersonic flights below 20,000 ft. Audible sonic booms within the Dry Tortugas National Park are predicted to be infrequent and at low received levels based on mitigation measures implemented by the Navy to reduce the occurrence of focused sonic booms in the Tortugas Military Operations Area. In addition, initial efforts by Florida Fish and Wildlife Conservation Commission and National Park Service biologists to reestablish a nesting colony of the federally listed roseate tern in the Dry Tortugas have been successful. During this time, Navy use of the Tortugas Military Operations Area and surrounding Special Use Airspace remained constant. Given the increase in nests coincident with air combat maneuver training, the aircraft training following guidelines of the Military Operations Area has likely had minimal impact on nesting roseate terns.

3.9.3.1.1.6 Long Term Consequences

Long-term consequences to birds and bats due to acoustic exposures are considered following the Conceptual Framework for Assessing Effects from Acoustic and Explosive Stressors (Section 3.0.3.6.1).

Long-term consequences due to individual behavioral reactions and short-term instances of physiological stress are especially difficult to predict because individual experience over time can create complex contingencies. It is more likely that any long-term consequences to an individual would be a result of costs accumulated over a season, year, or life stage due to multiple behavioral or stress responses resulting from exposures to multiple stressors over significant periods of time. Conversely, some birds and bats may habituate to or become tolerant of repeated acoustic exposures over time, learning to ignore a stimulus that in the past did not accompany any overt threat. Most research on long-term consequences to birds due to acoustic exposures has focused on breeding colonies or shore habitats, and does not address the brief exposures that may be encountered during migration or foraging at sea. More research is needed to better understand the long-term consequences of human-made noise on birds and bats, although intermittent exposures are assumed to be less likely than prolonged exposures to have lasting consequences.

3.9.3.1.2 Impacts from Sonar and Other Transducers

Sonar and other transducers emit sound waves into the water to detect objects, safely navigate, and communicate. Use of sonar and other transducers would typically be transient and temporary. General categories of sonar systems are described in Section 3.0.3.3.1 (Acoustic Stressors).

Impacts from sonar and other transducers are not applicable to bats because bats are an airborne species and will not be analyzed further in this section. In addition, there is no overlap of sonar and other transducer noise and piping plover critical habitat.

Information regarding the impacts of sonar on birds is unavailable, and little is known about the ability of birds to hear underwater. The limited information (Johansen et al., 2016) and data from other species suggest the range of best hearing may shift to lower frequencies in water (Dooling & Therrien, 2012; Therrien, 2014) (see Section 3.9.2.1.4, Hearing and Vocalization). Because few birds can hear above 10 kHz in air, it is likely that the only sonar sources they may be able to detect are low and mid-frequency sources.

Other than pursuit diving species, the exposure to birds by these sounds is likely to be negligible because they spend only a very short time underwater (plunge-diving or surface-dipping) or forage only at the water surface. Pursuit divers may remain underwater for minutes, increasing the chance of underwater sound exposure.

In addition to diving behavior, the likelihood of a bird being exposed to underwater sound depends on factors such as duty cycle (defined as the percentage of the time during which a sound is generated over a total operational period), whether the source is moving or stationary, and other activities that might be occurring in the area. When used, continuously active sonars transmit more frequently (greater than 80% duty cycle) than traditional sonars, but at a substantially lower source level. However, it should be noted that active sonar is rarely used continuously throughout the listed activities, and many sources are mobile. For moving sources such as hull-mounted sonar, the likelihood of an individual bird being repeatedly exposed to an intense sound source over a short period of time is low because the training activities are transient and sonar use and bird diving are intermittent. The potential for birds to be exposed to intense sound associated with stationary sonar sources would likely be limited for some training and testing activities because other activities occurring in conjunction may cause them to leave the immediate area. For example, birds would likely react to helicopter noise during dipping sonar exercises by flushing from the immediate area, and would, therefore, not be exposed to underwater sonar.

Injury due to acoustic resonance of air space in the lungs from sonar and other transducers is unlikely in birds. Unlike mammals, birds have compact, rigid lungs with strong pulmonary capillaries that do not change much in diameter when exposed to extreme pressure changes (Baerwald et al., 2008), leading to resonant frequencies lower than the frequencies used for Navy sources.

A physiological impact, such as hearing loss, would likely only occur if a seabird were close to an intense sound source. An underwater sound exposure would have to be intense and of a sufficient duration to cause hearing loss. Avoiding the sound by returning to the surface would limit extended or multiple sound exposures underwater. Additionally, some diving birds may avoid interactions with large moving vessels upon which the most powerful sonars are operated (Schwemmer et al., 2011). In general, birds are less susceptible to both temporary and PTS than mammals (Saunders & Dooling, 1974). Diving birds have adaptations to protect the middle ear and tympanum from pressure changes during diving that may affect hearing (Dooling & Therrien, 2012). While some adaptions may exist to aid in underwater hearing, other adaptations to protect in-air hearing may limit aspects of underwater hearing (Hetherington, 2008). Because of these reasons, the likelihood of a diving bird experiencing an underwater exposure to sonar or other transducers that could result in an impact to hearing is considered low.

Because diving birds may rely more on vision for foraging, and there is no evidence that diving birds rely on underwater acoustic communication for foraging (see Section 3.9.2.1.4, Hearing and Vocalization), the masking of important acoustic signals underwater by sonar or other transducers is unlikely.

There have been no studies documenting diving seabirds' reactions to sonar. However, given the information and adaptations discussed above, diving seabirds are not expected to detect high-frequency sources underwater and are only expected to detect mid- and low-frequency sources when in close proximity. A diving bird may not respond to an underwater source, or it may respond by altering its dive behavior, perhaps by reducing or ceasing a foraging bout. It is expected that any behavioral interruption would be temporary, as the source or the bird changes location.

Some birds commonly follow vessels, including certain species of gulls, storm petrels, and albatrosses, as there is increased potential of foraging success as the prop wake brings prey to the surface (Hamilton, 1958; Hyrenbach, 2001, 2006; Melvin et al., 2001). Birds that approach vessels while foraging are the most likely to be exposed to underwater active acoustic sources, but only if the ship is engaged in anti-submarine warfare or mine warfare with active acoustic sources. However, hull-mounted sonar does not project sound aft of ships (behind the ship, opposite the direction of travel), so most birds diving in ship wakes would not be exposed to sonar. In addition, based on what is known about bird hearing capabilities in air, it is expected that diving birds may have limited or no ability to perceive high-frequency sounds, so they would likely not be impacted by high-frequency sources such as those used in mine warfare.

3.9.3.1.2.1 Impacts from Sonar and Other Transducers Under Alternative 1

Impacts from Sonar and Other Transducers Under Alternative 1 for Training Activities

General categories and characteristics of sonar systems and the number of hours these sonars would be operated during training under Alternative 1 are described in Section 3.0.3.3.1 (Acoustic Stressors). Activities using sonars and other transducers would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions).

Under Alternative 1, the number of Major Training Exercises and Civilian Port Defense Activities would fluctuate annually. In addition, a portion of Anti-Submarine Warfare Tracking Exercise-Ship unit-level training activities would be conducted using synthetic means (e.g., simulators) or in conjunction with other training exercises. Training activities using sonar and other transducers could occur throughout the Study Area, although use would generally occur within Navy range complexes, on Navy testing ranges, or around inshore locations identified in Chapter 2 (Description of Proposed Action and

Alternatives). Use of sonars associated with anti-submarine warfare would be greatest in the Jacksonville and Virginia Capes Range Complexes.

Sonar and other transducers would not be regularly used in nearshore areas that could be used by foraging shorebirds, except during maintenance and for navigation in areas around ports. Therefore, birds that forage in open ocean areas would have a greater chance of underwater sound exposure than birds that forage in coastal areas.

The possibility of an ESA-listed bird species being exposed to sonar and other active acoustic sources depends on whether it submerges during foraging and whether it forages in areas where these sound sources may be used. Although Bermuda petrels forage in open ocean areas where sonar training occurs, it is unlikely they would be exposed to underwater sound because they typically forage at the surface and, if pursuit diving, only stay underwater for a short period (typically less than 10 seconds). The roseate tern's plunge-dive is shallow and brief in duration. Typical dives submerge less than the full body length of the tern with the duration of submergence seldom exceeding 1 to 2 seconds. Any exterior sound would be masked by the sound of the tern entering and exiting the water so no exposure is expected. Piping plovers and red knots do not submerge while foraging in intertidal areas; therefore, they would not be exposed to underwater sound from sonar and other active acoustic sources. Because impacts to individual birds, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Accordingly, there would be no consequences to any bird populations, and sonar and other transducers will not have a significant adverse effect on populations of migratory bird species.

Pursuant to the ESA, the use of sonar and other transducers during training events as described under Alternative 1 will have no effect on Indiana bats, northern long-eared bats, roseate terns, piping plovers, red knots, or piping plover critical habitat. The use of sonar and other transducers during training activities as described under Alternative 1 may affect Bermuda petrels. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Sonar and Other Transducers Under Alternative 1 for Testing

General categories and characteristics of sonar systems and the number of hours these sonars would be operated during testing under Alternative 1 are described in Section 3.0.3.3.1 (Acoustic Stressors). Activities using sonars and other transducers would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). Under Alternative 1, the number of testing activities would fluctuate annually.

Testing activities using sonar and other transducers could occur throughout the Study Area, although use would generally occur within Navy range complexes, on Navy testing ranges, or around inshore locations identified in Chapter 2 (Description of Proposed Action and Alternatives).

The possibility of an ESA-listed bird species being exposed to sonar and other active acoustic sources depends on whether it submerges during foraging and whether it forages in areas where these sound sources may be used. Although Bermuda petrels forage in open ocean areas where sonar testing occurs, it is unlikely they would be exposed to underwater sound because they typically forage at the surface and, if pursuit diving, only stay underwater for a short period (typically less than 10 seconds). The roseate tern's plunge-dive is shallow and brief in duration. Typical dives submerge less than the full body length of the tern with the duration of submergence seldom exceeding 1 to 2 seconds. Any exterior sound would be masked by the sound of the tern entering and exiting the water so no exposure is expected. Piping plovers and red knots do not submerge while foraging in intertidal areas; therefore, they would not be exposed to underwater sound from sonar and other active acoustic sources. Because impacts to individual birds, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Accordingly, there would be no consequences to any bird populations, and sonar and other transducers will not have a significant adverse effect on populations of migratory bird species.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 1 will have no effect on Indiana bats, northern long-eared bats, roseate terns, piping plovers, red knots, or piping plover critical habitat. The use of sonar and other transducers during testing activities as described under Alternative 1 may affect Bermuda petrels. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in that regard.

3.9.3.1.2.2 Impacts from Sonar and Other Transducers Under Alternative 2

Impacts from Sonar and Other Transducers Under Alternative 2 for Training Activities

General categories and characteristics of sonar systems and the number of hours these sonars would be operated during training under Alternative 2 are described in Section 3.0.3.3.1 (Acoustic Stressors). Activities using sonars and other transducers would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions).

Under Alternative 2, the maximum number of Major Training Exercises could occur every year, an additional Major Training Exercise would be conducted in the Gulf of Mexico Range Complex annually, and only the number of Civilian Port Defense Activities would fluctuate annually. In addition, all unit level Anti-Submarine Warfare Tracking Exercise-Ship activities would be completed through individual events conducted at sea, rather than through leveraging other anti-submarine warfare training exercises or the use of synthetic means (e.g., simulators). This would result in an increase of sonar use compared to Alternative 1. Training activities using sonar and other transducers could occur throughout the Study Area, although use would generally occur within Navy range complexes, on Navy testing ranges, or around inshore locations identified in Chapter 2 (Description of Proposed Action and Alternatives). Use of sonars associated with anti-submarine warfare would be greatest in the Jacksonville and Virginia Capes Range Complexes.

Sonar and other transducers would not be regularly used in nearshore areas that could be used by foraging shorebirds, except during maintenance and for navigation in areas around ports. Therefore, birds that forage in open ocean areas would have a greater chance of underwater sound exposure than birds that forage in coastal areas.

The possibility of an ESA-listed bird species being exposed to sonar and other active acoustic sources depends on whether it submerges during foraging and whether it forages in areas where these sound sources may be used. Although Bermuda petrels forage in open ocean areas where sonar training occurs, it is unlikely they would be exposed to underwater sound because they typically forage at the surface and, if pursuit diving, only stay underwater for a short period (typically less than 10 seconds). The roseate tern's plunge-dive is shallow and brief in duration. Typical dives submerge less than the full body length of the tern with the duration of submergence seldom exceeding 1 to 2 seconds. Any exterior sound would be masked by the sound of the tern entering and exiting the water so no exposure is expected. Piping plovers and red knots do not submerge while foraging in intertidal areas; therefore, they would not be exposed to underwater sound from sonar and other active acoustic sources. Because impacts to individual birds, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Accordingly, there would be no consequences to any bird populations, and sonar and other transducers will not have a significant adverse effect on populations of migratory bird species.

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 2 will have no effect on Indiana bats, northern long-eared bats, piping plover critical habitat, roseate terns, piping plovers, red knots, or piping plover critical habitat. The use of sonar and other transducers during training activities as described under Alternative 2 may affect Bermuda petrels.

Impacts from Sonar and Other Transducers Under Alternative 2 for Testing Activities

General categories and characteristics of sonar systems and the number of hours these sonars would be operated during testing under Alternative 2 are described in Section 3.0.3.3.1 (Acoustic Stressors). Activities using sonars and other transducers would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions).

Under Alternative 2, the maximum number of nearly all testing activities would occur every year. This would result in an increase of sonar use compared to Alternative 1.

Testing activities using sonar and other transducers could occur throughout the Study Area, although use would generally occur within Navy range complexes, on Navy testing ranges, or around inshore locations identified in Chapter 2 (Description of Proposed Action and Alternatives).

The possibility of an ESA-listed bird species being exposed to sonar and other active acoustic sources depends on whether it submerges during foraging and whether it forages in areas where these sound sources may be used. Although Bermuda petrels forage in open ocean areas where sonar testing occurs, it is unlikely they would be exposed to underwater sound because they typically forage at the surface and, if pursuit diving, only stay underwater for a short period (typically less than 10 seconds). The roseate tern's plunge-dive is shallow and brief in duration. Typical dives submerge less than the full body length of the tern with the duration of submergence seldom exceeding 1 to 2 seconds. Any exterior sound would be masked by the sound of the tern entering and exiting the water so no exposure is expected. Piping plovers and red knots do not submerge while foraging in intertidal areas; therefore, they would not be exposed to underwater sound from sonar and other active acoustic sources. Because impacts to individual birds, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Accordingly, there would be no consequences to any bird populations, and sonar and other transducers will not have a significant adverse effect on populations of migratory bird species.

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 2 will have no effect on Indiana bats, northern long-eared bats, roseate terns, piping plovers, red knots, or piping plover critical habitat. The use of sonar and other transducers during testing activities as described under Alternative 2 may affect Bermuda petrels.

3.9.3.1.2.3 Impacts from Sonar and Other Transducers Under No Action Alternative

Impacts from Sonar and Other Transducers Under No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the training and testing activities in the AFTT Study Area. Various acoustic stressors (e.g., sonar and other transducers) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.9.3.1.3 Impacts from Air Guns

Air guns can introduce brief impulsive, broadband sounds into the marine environment. Section 3.0.3.3.1.2 (Air Guns) provides additional details on the use and acoustic characteristics of the small underwater air guns used during Navy activities.

Impulses from air guns used by the Navy lack the strong shock wave and rapid pressure increases of explosions that can cause primary blast injury or barotraumas. Underwater impulses would be generated using small (approximately 60 cubic in.) air guns, which are essentially stainless steel tubes charged with high-pressure air via a compressor. An impulsive sound is generated when the air is almost instantaneously released into the surrounding water, an effect similar to popping a balloon in air. Generated impulses would have short durations, typically a few hundred milliseconds.

Impacts from air guns are not applicable to bats because bats are an airborne species and will not be analyzed further in this section. In addition, there is no overlap of air gun noise and piping plover critical habitat.

The exposure to these sounds by birds, other than pursuit diving species, would be negligible because they spend only a very short time underwater (plunge-diving or surface-dipping) or forage only at the water surface. Pursuit divers may remain underwater for minutes, increasing the chance of underwater sound exposure. However, the short duration of an air gun pulse and its relatively low source level means that a bird would have to be very close to a small air gun used in Navy activities at the moment of discharge to be exposed. In addition, air guns may be fired at greater depths than birds conduct their foraging dives. Because of these reasons, the likelihood of a diving bird experiencing an underwater exposure to an air gun that could result in an impact to hearing is negligible.

Because diving birds may rely more on vision for foraging, there is no evidence that diving birds rely on underwater acoustic communication for foraging (see Section 3.9.2.1.4, Hearing and Vocalization), and the signal from an air gun is very brief, the masking of important acoustic signals underwater by an air gun is unlikely.

The limited data on behavioral reactions to underwater impulsive noise suggest that birds are unlikely to exhibit any notable behavioral reaction toward a small air gun (see Section 3.9.3.1.1.5, Behavioral Reactions).

3.9.3.1.3.1 Impacts from Air Guns Under Alternative 1

Impacts form Air Guns Under Alternative 1 for Training Activities

Training activities under Alternative 1 do not use air guns.

Impacts from Air Guns Under Alternative 1 for Testing

Characteristics of air guns and the number of times they would be operated during testing under Alternative 1 are described in Section 3.0.3.3.1 (Acoustic Stressors). Activities using air guns would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions).

Under Alternative 1, small air guns (12 - 60 in.^{3}) would be fired pierside at Newport, Rhode Island and at offshore locations typically in the Northeast, Virginia Capes, and Gulf of Mexico Range Complexes.

The possibility of an ESA-listed seabird species being exposed to sounds from air guns depends on whether it submerges during foraging and whether it forages in areas where this sound source may be used. Although Bermuda petrels forage in open ocean areas where some air gun use occurs, it is unlikely they would be exposed to underwater sound because they typically forage at the surface and, if pursuit diving, only stay underwater for a short period (typically less than 10 seconds). Red knots and piping plovers do not submerge while foraging; therefore, they would not be exposed to underwater sound from air guns. Because roseate terns only briefly submerge while plunge-diving during foraging in coastal shallow waters, their risk of air gun exposure is negligible. As discussed above, impacts to individual birds, if any, are expected to be minor and limited. No long-term consequences to individuals are expected. Accordingly, there would be no consequences to any bird populations, and air guns will not have a significant adverse effect on populations of migratory bird species.

Pursuant to the ESA, the use of air guns during testing activities as described under Alternative 1 will have no effect on Indiana bats, northern long-eared bats, piping plovers, roseate terns, red knots, or piping plover critical habitat. The use of air guns during testing activities as described under Alternative 1 may affect Bermuda petrels. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in that regard.

3.9.3.1.3.2 Impacts from Air Guns Under Alternative 2

Impacts from Air Guns Under Alternative 2 for Training Activities

Training activities under Alternative 2 do not use air guns.

Impacts from Air Guns Under Alternative 2 for Testing Activities

Air gun testing activities planned under Alternative 2 are identical to those planned under Alternative 1; therefore, the estimated impacts would be identical. Because impacts to individual birds, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Accordingly, there would be no consequences to any bird populations, and air guns will not have a significant adverse effect on populations of migratory bird species.

Pursuant to the ESA, the use of air guns during testing activities as described under Alternative 2 will have no effect on Indiana bats, northern long-eared bats, piping plovers, roseate terns, red knots, or piping plover critical habitat. The use of air guns during testing activities as described under Alternative 2 may affect Bermuda petrels.

3.9.3.1.3.3 Impacts from Air Guns Under No Action Alternative

Impacts from Air Guns Under No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the training and testing activities in the AFTT Study Area. Various acoustic stressors (e.g., air guns) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.9.3.1.4 Impacts from Pile Driving

Impact pile driving and vibratory pile extraction would occur during construction of an Elevated Causeway System, a temporary pier that allows the offloading of ships in areas without a permanent port. Installation of piles would involve the use of an impact hammer mechanism and pile extraction would involve using the vibratory mechanism. These activities would occur over multiple days, although noise generated by the actual pile driving and extraction would only occur over a portion of any given day (generally an hour or less in total). Section 3.0.3.3.1.3 (Pile Driving) provides additional details on pile driving activities and the noise levels measured from a prior elevated causeway installation and removal.

Noise from the installation and removal of piles has a potential to affect animals in the vicinity of the training event. Impact pile driving creates repetitive impulsive sound. An impact pile driver generally operates in the range of 36–50 blows per minute. Vibratory pile extraction creates a nearly continuous sound made up of a series of short duration rapid impulses at a much lower source level than impact pile driving. The sounds are emitted both in the air and in the water in nearshore areas where some birds forage. It is expected that most birds would exhibit avoidance behavior and leavethe pile driving location. However, if prey species such as fish are killed or injured as a result of pile driving, some birds may continue to forage close to the construction area, or may be attracted to the area, and be exposed to associated noise. Behavioral responses and displacement from the area are expected to be temporary for the duration of the pile driving and extraction activities. Bats may be exposed to the in-air noise from pile driving installation and extraction.

Impulses from the impact hammer are broadband and carry most of their energy in the lower frequencies. The underwater SPLs produced by impact pile driving during Navy activities are below the conservatively estimated injury thresholds recommended for other small animals with similar sized air cavities [sea turtles and fish; see Popper et al. (2014)]. Therefore, the risk of barotrauma to any diving birds is negligible. Impulses from the impact hammer attenuate more quickly in air than in water and birds are likely to avoid the area during impact driving. Therefore, the risk of barotrauma to birds in air or at the water surface is negligible.

Pursuit divers may remain underwater for minutes, increasing the chance of underwater sound exposure. However, the short duration of driving or extracting a single pile would limit the likelihood of exposure, especially since a bird that is disturbed by pile driving while underwater may respond by swimming to the surface. Although it is not known what duration or intensity of underwater sound exposure would put a bird at risk of hearing loss, birds are less susceptible to both temporary and PTS than mammals (Saunders & Dooling, 1974). Diving birds have adaptations to protect the middle ear and tympanum from pressure changes during diving that may affect hearing (Dooling & Therrien, 2012). While some adaptions may exist to aid in underwater hearing, other adaptations to protect in-air hearing may limit aspects of underwater hearing (Hetherington, 2008). Because of these reasons, the likelihood of a diving bird experiencing an underwater exposure to impact pile driving that could affect hearing is considered low. Vibratory pile extraction sound levels are low and are not considered to pose a risk to bird hearing in air or in water.

Because diving birds may rely more on vision for foraging, there is no evidence that diving birds rely on underwater acoustic communication for foraging (see Section 3.9.2.1.4, Hearing and Vocalization), and individual pile driving and extraction occurs only over a few minutes, the masking of important acoustic signals underwater by pile driving is unlikely. The potential for masking of calls in air would also likely be limited because of the short duration of individual pile driving and extraction and the likelihood that birds would avoid the area around pile driving activities.

Responses by birds to noise from pile driving would be short-term behavioral or physiological responses (e.g., alert response, startle response, and temporary increase in heart rate). Startle or alert reactions are not likely to disrupt major behavior patterns such as migrating, breeding, feeding, and sheltering, or to result in serious injury to any birds. Some birds may be attracted to the area to forage forn prey species killed or injured as a result of pile driving and be exposed to noise from pile driving temporarily. Birds may be temporarily displaced and there may be temporary increases in stress levels; however, behavior and use of habitat would return shortly after the training is complete.

3.9.3.1.4.1 Impacts from Pile Driving Under Alternative 1

Impacts form Pile Driving Under Alternative 1 for Training Activities

Characteristics of pile driving and the number of times pile driving for the Elevated Causeway System would occur during training under Alternative 1 are described in Section 3.0.3.3.1 (Acoustic Stressors). Activities with pile driving would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). This activity would take place nearshore and within the surf zone up to two times per year, once at Joint Expeditionary Base Little Creek-Fort Story, Virginia and once at Marine Corps Base Camp Lejeune, North Carolina.

The impact of noise produced by pile driving and extraction would be short-term and localized. Birds in the close vicinity are expected to most likely respond by increasing distance from pile driving and extraction activities, or not respond at all to extraction activities. As discussed above, impacts to individual birds or bats, if any, are expected to be minor and limited. No long-term consequences to individuals are expected. Accordingly, there would be no consequences to any bird or bat populations and pile driving will not have a significant adverse effect on populations of migratory bird species.

Bermuda petrels are unlikely to be present in coastal areas where pile driving could occur. Piping plovers, roseate terns, and red knots may be present in coastal areas where pile driving could occur, depending on time of year. None of these species are pursuit divers; therefore, there would be no risk from underwater pile driving noise exposure. If present, birds of these species may be exposed to in-air noise from pile driving, but would be expected to avoid the area around active impact pile driving and extraction construction activities. Pile driving activities would not occur at beaches that are designated as piping plover critical habitat. Bats may be exposed to the in-air noise from pile driving installation and extraction; however, most of the energy from pile driving would be carried in the lower frequencies out of the hearing range of bats.

Pursuant to the ESA, the use of pile driving during training activities described under Alternative 1 will have no effect on piping plover critical habitat. The use of pile driving during training activities described under Alternative 1 may affect piping plovers, Bermuda petrels, roseate terns, red knots, Indiana bats, and northern long-eared bats. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Pile Driving Under Alternative 1 for Testing

Testing activities under Alternative 1 do not include pile driving.

3.9.3.1.4.2 Impacts from Pile Driving Under Alternative 2

Impacts from Pile Driving Under Alternative 2 for Training Activities

Pile driving training activities planned under Alternative 2 are identical to those planned under Alternative 1; therefore, the estimated impacts would be identical. Because impacts on individual birds and bats, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Accordingly, there would be no consequences to any bird or bat populations, and pile driving will not have a significant adverse effect on populations of migratory bird species.

Pursuant to the ESA, the use of pile driving during training activities described under Alternative 2 will have no effect on piping plover critical habitat. The use of pile driving during training activities described under Alternative 2 may affect piping plovers, Bermuda petrels, roseate terns, red knots, Indiana bats, and northern long-eared bats.

Impacts from Pile Driving Under Alternative 2 for Testing Activities

Testing activities under Alternative 2 do not include pile driving.

3.9.3.1.4.3 Impacts from Pile Driving Under No Action Alternative

Impacts from Pile Driving Under No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the training and testing activities in the AFTT Study Area. Various acoustic stressors (e.g., pile driving) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.9.3.1.5 Impacts from Vessel Noise

The training and testing proposed in the Study Area involve maneuvers by various types of surface ships, boats, submarines, and unmanned vehicles (collectively referred to as vessels) (see Section 3.0.3.3.1.4, Vessel Noise). Birds could be exposed to both in-air and underwater noise from vessels throughout the Study Area and bats may be exposed to in-air noise from vessels throughout the Study Area, but few exposures would occur based on the infrequency of operations and the low density of vessels within the Study Area at any given time. Potential for exposure to vessel noise due to Navy activities would be greatest near Navy ports.

Birds respond to vessels in various ways. Some birds are commonly attracted to and follow vessels including certain species of gulls, storm-petrels, and albatrosses (Hamilton, 1958; Hyrenbach, 2001, 2006), while other species such as frigatebirds, sooty terns, and a variety of diving birds seem to avoid vessels (Borberg et al., 2005; Hyrenbach, 2006; Schwemmer et al., 2011). Vessel noise could elicit short-term behavioral or physiological responses but are not likely to disrupt major behavior patterns, such as migrating, breeding, feeding, and sheltering, or to result in serious injury to any birds. Harmful bird/vessel interactions are commonly associated with commercial fishing vessels because birds are attracted to concentrated food sources around these vessels (Dietrich & Melvin, 2004; Melvin & Parrish, 2001). The concentrated food sources (catch and bycatch) that attract birds to commercial fishing vessels are not present around Navy vessels.

Although loud sudden noises can startle and flush birds, Navy vessels are not expected to result in major acoustic disturbance of birds in the Study Area. The continuous noise from Navy vessels has the potential to cause masking for birds, both in air and underwater. Due to the transient nature of Navy vessels, this masking is expected to be temporary. Birds near ports may experience increased masking and become habituated to this noise or attempt to compensate for the masking. Noises from Navy vessels are similar to or less than those of the general maritime environment. Birds may respond to the physical presence of a vessel, regardless of the associated noise (See section 3.9.3.4.1, Impacts from Vessels and In-water Devices).

Very little is known about the impact of vessel noise on bats, although studies of vehicle noise suggest that the distance from and number of passing vehicles affect the intensity of the acoustic habitat degradation, which will affect bats' behavior (Schaub et al., 2008). Bats have been known to temporarily roost on vessels along their migration routes as noted in Section 3.9.2.1 (General Background). Anecdotal evidence exists for the ability of bats to cope with considerable background noise in non-foraging situations (Schaub et al., 2008). Navy vessels are not expected to result in major acoustic disturbance of bats in the Study Area.

3.9.3.1.5.1 Impacts from Vessel Noise Under Alternative 1

Impacts form Vessel Noise Under Alternative 1 for Training Activities

Characteristics of Navy vessel noise are described in Section 3.0.3.3.1 (Acoustic Stressors). Activities with vessel noise would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). Navy vessel traffic could occur anywhere within the Study Area, but would be concentrated near the Norfolk and Mayport Navy ports and within the Virginia Capes, Navy Cherry Point, and Jacksonville Range Complexes. Navy vessel noise would continue to be a minor contributor to overall radiated vessel noise in the exclusive economic zone. A study of Navy vessel traffic found that traffic was heaviest just offshore between the mouth of the Chesapeake Bay and Jacksonville, FL, with very little Navy vessel traffic in the Northeast or Gulf of Mexico Range Complexes (Mintz, 2012). There is no overlap of vessel noise and piping plover critical habitat.

A bird in the open ocean could be exposed to vessel noise as the vessel passes. Birds foraging or migrating through a training area in the open ocean may respond by avoiding areas of temporarily concentrated vessel noise. Exposures to most seabirds would be infrequent, based on the brief duration and dispersed nature of the vessels.

If a bird or bat responds to vessel noise, only short-term behavioral responses such as startle responses, head turning, or avoidance responses would be expected. Repeated exposures would be limited due to the transient nature of vessel use and regular movement of birds and bats. Because impacts to individual birds and bats, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Accordingly, there would be no consequences to any bird or bat populations, and vessel noise will not have a significant adverse effect on populations of migratory bird species.

Coastal roseate terns, red knots, and piping plovers could be exposed to intermittent vessel noise along the coast. If present in the open water areas where training activities involving vessel noise occur, roseate terns, red knots, Bermuda petrels, Indiana bats, and northern long-eared bats could be temporarily disturbed while foraging or migrating.

Pursuant to the ESA, vessel noise during training activities as described under Alternative 1 will have no effect on piping plover critical habitat. Vessel noise during training activities as described under Alternative 1 may affect roseate terns, red knots, Bermuda petrels, piping plovers, Indiana bats, and northern long-eared bats. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Vessel Noise Under Alternative 1 for Testing

Characteristics of Navy vessel noise are described in Section 3.0.3.3.1 (Acoustic Stressors). Activities with vessel noise would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). Testing activities within the Study Area typically consist of a single vessel involved in unit-level activity for a few hours, one or two small boats conducting testing, or during a larger training event. Navy vessel traffic could occur anywhere within the Study Area, primarily concentrated within the Jacksonville and Virginia Capes Range Complexes; the Northeast Range Complexes and adjacent inshore waters, especially near the Naval Underwater Warfare Center Newport Testing Range; and in the Gulf of Mexico, especially in areas near Naval Surface Warfare Center, Panama City Division Testing Range. There is no overlap of vessel noise and piping plover critical habitat.

A bird or bat in the open ocean could be exposed to vessel noise as the vessel passes. Birds and bats foraging or migrating through a testing area in the open ocean may respond by avoiding areas of temporarily concentrated vessel noise. Exposures to most birds and bats would be infrequent, based on the brief duration and dispersed nature of the vessels.

If a bird or bat responds to vessel noise, only short-term behavioral responses such as startle responses, head turning, or avoidance responses would be expected. Repeated exposures would be limited due to the transient nature of vessel use and regular movement of birds and bats. Because impacts to individual birds or bats, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Accordingly, there would be no consequences to any bird or bat populations, and vessel noise will not have a significant adverse effect on populations of migratory bird species.

Coastal roseate terns, red knots, and piping plovers could be exposed to intermittent vessel noise along the coast. If present in the open water areas where testing activities involving vessel noise occur, roseate terns, red knots, Bermuda petrels, Indiana bats, and northern long-eared bats could be temporarily disturbed while foraging or migrating.

Pursuant to the ESA, vessel noise during testing activities as described under Alternative 1 will have no effect on piping plover critical habitat. Vessel noise during testing activities as described under Alternative 1 may affect roseate terns, red knots, Bermuda petrels, piping plovers, Indiana bats, and northern long-eared bats. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in that regard.

3.9.3.1.5.2 Impacts from Vessel Noise Under Alternative 2

Impacts from Vessel Noise Under Alternative 2 for Training Activities

While there would be an increase in the amount of at-sea vessel time during training under Alternative 2, the general locations and types of effects due to vessel noise would be the same as described in Alternative 1. Therefore, the general locations and types of effects due to vessel noise described above for training under Alternative 1 would be similar under Alternative 2. Navy vessel noise would continue to be a minor contributor to overall radiated vessel noise in the exclusive economic zone.

Pursuant to the ESA, vessel noise during training activities as described under Alternative 2 will have no effect on piping plover critical habitat. Vessel noise during training activities as described under Alternative 2 may affect roseate terns, red knots, Bermuda petrels, piping plovers, Indiana bats, and northern long-eared bats.

Impacts from Vessel Noise Under Alternative 2 for Testing Activities

The difference in vessel noise contributed by testing activities under Alternative 2 compared to Alternative 1 is so small as to not be discernable. Therefore, the general locations and types of effects due to vessel noise described above for testing under Alternative 1 would be the same under Alternative 2. Navy vessel noise would continue to be a minor contributor to overall radiated vessel noise in the exclusive economic zone.

Pursuant to the ESA, vessel noise during testing activities as described under Alternative 2 will have no effect on piping plover critical habitat. Vessel noise during testing activities as described under Alternative 2 may affect roseate terns, red knots, Bermuda petrels, piping plovers, Indiana bats, and northern long-eared bats.

3.9.3.1.5.3 Impacts from Vessel Noise Under No Action Alternative

Impacts from Vessel Noise Under No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the training and testing activities in the AFTT Study Area. Various acoustic stressors (e.g., vessel noise) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.9.3.1.6 Impacts from Aircraft Noise

Birds and bats could be exposed to airborne noise associated with subsonic and supersonic fixed-wing aircraft and helicopter overflights while foraging or migrating in open water, nearshore, or coastal environments within the Study Area. Tilt-rotor impacts would be similar to fixed-wing or helicopter impacts depending which mode the aircraft is in. A description of aircraft noise produced during Navy activities is provided in Section 3.0.3.3.1.5 (Aircraft Overflight Noise).

Exposure to fixed-wing aircraft noise would be brief as an aircraft quickly passes overhead. Exposures would be infrequent based on the transitory and dispersed nature of the overflights; repeated exposure of individual birds and bats over a short period of time (hours or days) is unlikely. Birds repeatedly exposed to aircraft noise often become habituated to the noise and do not respond behaviorally (Larkin et al., 1996; National Park Service, 1994; Plumpton, 2006). However, habituation seems unlikely in the Study Area given the widely dispersed and infrequent nature of the operations.

Common behavioral responses of wildlife to aircraft noise include no response or stationary alert behavior (Johnson & Reynolds, 2002), startle response, flying away, and increased vocalizations (Bowles, 1995; Larkin et al., 1996; National Park Service, 1994). In some instances, behavioral responses could interfere with breeding, raising young, foraging, habitat use, and physiological energy budgets, particularly when an animal continues to respond to repeated exposures. The potential for masking of calls in air is possible if a bird or bat remains in the area; however, due to the transitory nature of aircraft overflights, the duration of masking would be limited.

Some air combat maneuver training would involve high altitude, supersonic flight, which would produce sonic booms, but such airspeeds would be infrequent and are typically conducted at high altitudes and far from shore, limiting the areas where birds and bats could be exposed. Boom duration is generally less than 300 milliseconds. Sonic booms would cause seabirds to startle, but the exposure would be brief, and any reactions are expected to be short-term. Startle impacts range from altering behavior (e.g., stop feeding or preening), minor behavioral changes (e.g., head turning), or at worst, a flight response. Because most fixed-wing flights are not supersonic and birds, bats, and aircraft are transient in any area, exposure of birds and bats in the open ocean to sonic booms would be infrequent. It is unlikely that individual birds or bats would be repeatedly exposed to sonic booms in the open ocean.

Helicopters typically operate below 1,000 ft. (304.8 m) altitude and often occur as low as 75–100 ft. (22.9–30.5 m) altitude. This low-altitude increases the likelihood that birds and bats would respond to noise from helicopter overflights with reactions such as flushing (Stalmaster & Kaiser, 1997), although a large portion of birds may exhibit no reaction to nearby helicopters (Grubb et al., 2010). Helicopters travel at slower speeds (less than 100 knots) which increases the duration of noise exposure compared to fixed-wing aircraft. Helicopter flights are generally limited to locations closer to the coast, unless deployed onboard ships. Helicopter flights, therefore, are more likely to impact the greater numbers of birds and bats that forage in coastal areas than those that forage in open ocean areas. Nearshore areas of the coast are the primary foraging habitat for many bird species. The presence of dense aggregations of sea ducks, other seabirds, and migrating land birds is a potential concern during low-altitude helicopter activities. Although birds may be more likely to react to helicopters than to fixed-wing aircraft, Navy helicopter pilots avoid large flocks of birds to protect aircrews and equipment, thereby reducing disturbance to birds as well. Within the Virginia Capes Range Complex, during mine countermeasure and neutralization activities, helicopters will remain at least 1 nautical miles (NM) from the beach except when transiting offshore. When transiting from Norfolk Naval Station to waters offshore, helicopters will avoid overflying Fisherman Island National Wildlife Refuge off the coast of Cape Charles, Virginia by at least 3,000 ft. vertically and horizontally to avoid disturbing ESA-listed piping plovers and other birds. Noise from low-altitude helicopter overflights would only be expected to elicit short-term behavioral or physiological responses in exposed birds and bats.

Birds in areas that may experience repeated exposure often habituate and do not respond behaviorally (Larkin et al., 1996; National Park Service, 1994; Plumpton, 2006). Throughout the Study Area, repeated exposure of individual birds or groups of birds is unlikely based on the dispersed nature of the overflights and the capability of birds to avoid or rapidly vacate an area of disturbance. Therefore, the general health of individual birds would not be compromised. Although no studies have been conducted specifically investigating the impact of aircraft noise on bats, bats are expected to adjust their call frequency when in the presence of high-frequency sounds within their own range of emissions as well as avoid areas of high levels of broadband background noise (Bates et al., 2008). Therefore, if the aircraft noise were within the bats' hearing range the area would be expected to be avoided or the bat would adjust their call frequency. Occasional startle or alert reactions to aircraft noise are not likely to disrupt major behavior patterns (such as migrating, breeding, feeding, and sheltering) or to result in serious injury to any birds or bats.

3.9.3.1.6.1 Impacts from Aircraft Noise Under Alternative 1

Impacts form Aircraft Noise Under Alternative 1 for Training Activities

Characteristics of aircraft noise are described in Section 3.0.3.3.1 (Acoustic Stressors) and the number of training activities that include aircraft under Alternative 1 are shown in Section 3.0.3.3.4.4 (Aircraft). Training activities with aircraft would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). Aircraft overflights would usually occur near Navy airfields, installations, and in special use airspace within Navy range complexes. Aircraft flights during training would be most concentrated within the Virginia Capes, Navy Cherry Point, Jacksonville, and Key West Range Complexes.

Most helicopter training would occur adjacent to fleet concentration areas at Naval Station Norfolk (including lower Chesapeake Bay and inshore estuarine areas) and at Naval Station Mayport, Jacksonville, Florida; in Onslow Bay, North Carolina; and in the waters off the coast of Naval Surface Warfare Center, Panama City Testing Range. Helicopters use the shortest route available and do not fly adjacent to the coastline when flying to the training and testing areas. Takeoffs and landings on vessels at sea would occur at unspecified locations throughout the Study Area.

Navy aircraft training activities over the Atlantic Ocean are concentrated near the outer continental shelf and the Gulf Stream. Pelagic birds that forage offshore may have greater presence in these productive areas. A bird in the open ocean could be exposed for a few seconds to fixed-wing aircraft noise as the aircraft quickly passes overhead. If present in the open water areas where training activities involving aircraft overflights occur, roseate terns, red knots, Bermuda petrels, Indiana bats, and northern long-eared bats could be temporarily disturbed while foraging or migrating. Birds foraging or migrating through a training area in the open ocean may respond by avoiding areas of temporarily concentrated aircraft noise. Exposures to most seabirds would be infrequent, based on the brief duration and dispersed nature of the overflights.

Most helicopter activities are transient in nature, although helicopters could also hover for extended periods. Activities involving helicopters would occur closer to the coast and in inshore estuarine locations. Activities involving helicopters may occur for extended periods of time, up to a couple of hours in some areas, increasing the potential for exposure. In addition to daytime activities, activities involving helicopters could also occur at night, increasing the potential for exposure to bats. During these activities, helicopters would typically transit throughout an area and may hover over the water. Longer activity durations and periods of time where helicopters hover may increase the potential for behavioral reactions, startle reactions, and physiological stress. However, the likelihood that birds or bats would remain in the immediate vicinity while an aircraft or helicopter transits directly nearby would be low. Helicopters that hover in a fixed location for an extended period of time could increase the potential for exposure. However, impacts from training activities would be highly localized and concentrated in space and duration.

If a bird or bat responds to aircraft noise, only short-term behavioral responses such as startle responses, head turning, or avoidance responses would be expected. Repeated exposures would be limited due to the transient nature of aircraft use and regular movement of birds and bats. Because impacts to individual birds and bats, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Accordingly, there would be no consequences to any bird or bat populations, and aircraft overflight noise will not have a significant adverse effect on populations of migratory bird species. Within the Virginia Capes Range Complex, during mine countermeasure and neutralization activities, helicopters will remain at least 1 NM from the beach except when transiting offshore. When transiting from Norfolk Naval Station to waters offshore, helicopters will avoid overflying Fisherman Island National Wildlife Refuge off the coast of Cape Charles, Virginia by at least 3,000 ft. vertically and horizontally to avoid disturbing ESA-listed piping plovers and other birds.

Critical habitat for wintering piping plovers is designated in the Marquesas Keys. Although there could be intermittent increases in ambient noise levels, aircraft overflights would not impact the ability of critical habitat designated in the Marquesas Keys to support roosting, refuge, or feeding of wintering piping plovers.

Pursuant to the ESA, aircraft noise during training activities as described under Alternative 1 will have no effect on piping plover critical habitat. Aircraft noise during training activities as described under Alternative 1 may affect roseate terns, red knots, piping plovers, Bermuda petrels, Indiana bats, and northern long-eared bats. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Aircraft Noise Under Alternative 1 for Testing

Characteristics of aircraft noise are described in Section 3.0.3.3.1 (Acoustic Stressors) and the number of testing activities with aircraft under Alternative 1 are shown in Section 3.0.3.3.4.4. (Aircraft). Testing activities using aircraft would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). Aircraft overflights would usually occur near Navy airfields, installations, and in special use airspace within Navy range complexes. Testing activities with aircraft would be most concentrated in the Virginia Capes Range Complex.

Flights involving sonic booms would occur in the area of the Delmarva Peninsula in Virginia Capes, which has the potential to result in startle responses from foraging piping plovers, red knots, and roseate terns, as well as nesting piping plovers. These flights occur offshore and parallel to the peninsula, and up to 60 percent involve a turn towards shore. Of the scheduled flights, only 85 percent may actually go supersonic. Only 30 percent of the flights will be conducted below 20,000 ft., and none of these flights will be conducted below 5,000 ft.

Navy aircraft testing activities over the Atlantic Ocean are concentrated near the outer continental shelf and the Gulf Stream. Pelagic birds that forage offshore may have greater presence in these productive areas. A bird or bat in the open ocean could be exposed for a few seconds to fixed-wing aircraft noise as the aircraft quickly passes overhead. If present in the open water areas where testing activities involving aircraft overflights occur, roseate terns, red knots, Bermuda petrels, Indiana bats, and northern long-eared bats could be temporarily disturbed while foraging or migrating. Birds and bats foraging or migrating through a training area in the open ocean may respond by avoiding areas of temporarily concentrated aircraft noise. Exposures to most birds and bats would be infrequent, based on the brief duration and dispersed nature of the overflights.

Most helicopter activities are transient in nature, although helicopters could also hover for extended periods. Activities involving helicopters would occur closer to the coast and in inshore estuarine locations. Activities involving helicopters may occur for extended periods of time, up to a couple of hours in some areas, increasing the potential for exposure. In addition to daytime activities, activities involving helicopters could also occur at night, increasing the potential for exposure to bats. During these activities, helicopters would typically transit throughout an area and may hover over the water. Longer activity durations and periods of time where helicopters hover may increase the potential for behavioral reactions, startle reactions, and physiological stress. However, the likelihood that birds or bats would remain in the immediate vicinity while an aircraft or helicopter transits directly nearby would be low. Helicopters that hover in a fixed location for an extended period of time could increase the potential for exposure. However, impacts from training activities would be highly localized and concentrated in space and duration.

If a bird or bat responds to aircraft noise, only short-term behavioral responses such as startle responses, head turning, or avoidance responses would be expected. Repeated exposures would be limited due to the transient nature of aircraft use and regular movement of birds and bats. Because impacts to individual birds or bats, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Accordingly, there would be no consequences to any bird or bat populations, and aircraft overflight noise will not have a significant adverse effect on populations of migratory bird species.

Critical habitat for wintering piping plovers is designated in the Marquesas Keys. Although there could be intermittent increases in ambient noise levels, aircraft overflights would not impact the ability of critical habitat designated in the Marquesas Keys to support roosting, refuge, or feeding of wintering piping plovers.

Pursuant to the ESA, aircraft overflight noise during testing activities as described under Alternative 1 will have no effect on piping plover critical habitat. Aircraft noise during testing activities as described under Alternative 1 may affect roseate terns, red knots, piping plovers, Bermuda petrels, Indiana bats, and northern long-eared bats. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in that regard.

3.9.3.1.6.2 Impacts from Aircraft Noise Under Alternative 2

Impacts from Aircraft Noise Under Alternative 2 for Training Activities

There would be minor increase in aircraft overflights under Alternative 2 compared to Alternative 1; however, the types of impacts would not be discernible from those described for training under Alternative 1.

Pursuant to the ESA, aircraft overflight noise during training activities as described under Alternative 2 will have no effect on piping plover critical habitat. Aircraft noise during training activities as described under Alternative 2 may affect roseate terns, red knots, piping plovers, Bermuda petrels, Indiana bats, and northern long-eared bats.

Impacts from Aircraft Noise Under Alternative 2 for Testing Activities

There would be a minor increase in aircraft overflights under Alternative 2 compared to Alternative 1; however, the types of impacts would not be discernible from those described for testing under Alternative 1.

Pursuant to the ESA, aircraft overflight noise during testing activities as described under Alternative 2 will have no effect on piping plover critical habitat. Aircraft noise during testing activities as described under Alternative 2 may affect roseate terns, red knots, piping plovers, Bermuda petrels, Indiana bats, and northern long-eared bats.

3.9.3.1.6.3 Impacts from Aircraft Noise Under No Action Alternative

Impacts from Aircraft Noise Under No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the training and testing activities in the AFTT Study Area. Various acoustic stressors (e.g., aircraft noise) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.9.3.1.7 Impacts from Weapons Noise

Birds and bats may be exposed to sounds caused by the firing of weapons, objects in flight, and the impact of non-explosive projectiles on the water's surface. Other devices intentionally produce noise to serve as a non-lethal deterrent. These sounds are described in Section 3.0.3.3.1.6 (Weapons Noise). Navy training activities in the Study Area include firing or launching a variety of weapons, including missiles; rockets; and small-, medium-, and large-caliber projectiles. Most weapons firing activities occur far from shore, limiting most possible exposures to birds that forage or migrate greater than 3 NM offshore. In addition to noise from weapons firing and launching, birds and bats could be briefly disturbed by the impact of non-explosive practice munitions at the water surface. Because of the potential for blast injury due to explosives, the impacts due to explosive munitions and other explosives used during Navy activities are discussed in Section 3.9.3.2.2 (Impacts from Explosives).

Sounds produced by weapons firing (muzzle blast), launch boosters, and projectile travel are potential stressors to birds and bats. Sound generated by a muzzle blast is intense, but very brief. A bird or bat very close to a large weapons blast could be injured or experience hearing loss due to acoustic trauma or threshold shift. Sound generated by a projectile travelling at speeds greater than the speed of sound can produce a low amplitude bow shock wave in a narrow area around its flight path. Inert objects hitting the water surface would generate a splash and the noise may disturb nearby birds and bats. Bird and bat responses to weapons-firing and projectile travel noise may include short-term behavioral or physiological responses such as alert responses, startle responses, or temporary increases in heart rate. Studies of impacts of weapons noise on raptors show that these birds show little reaction (e.g., head turn) and do not alter behavior in the presence of noise from weapons testing (Brown et al., 1999; Schueck et al., 2001; Stalmaster & Kaiser, 1997). Once surface weapons firing activities begin, birds and bats would likely disperse away from the area around the ship and the path of projectiles if disturbed.

Other activities in the general area that precede these activities, such as vessel movement or target setting, could potentially disperse birds away from the area in which weapons-firing noise would occur. Species such as frigatebirds and sooty terns seem to avoid vessels (Borberg et al., 2005; Hyrenbach, 2006). Increased ship activity could drive these and other species from their natural habitat at a critical time or in an important foraging area (Borberg et al., 2005). On the other hand, some birds commonly follow vessels, including certain species of gulls, storm petrels, and albatrosses (Hamilton, 1958; Hyrenbach, 2001, 2006). A number of bird species are attracted to ships because of the increased potential for foraging success (Dietrich & Melvin, 2004; Melvin et al., 2001). The propeller wake generated by all ships, but particularly larger ships, disrupts the water column, causing prey to be brought to the surface where it is more easily captured by a greater variety of bird species. Birds that are attracted to ships could be more likely to be exposed to weapons firing noise.

Airborne weapons firing at airborne targets typically occur at high altitudes of 15,000–25,000 ft. during air-to-air gunnery exercises. Noise generated by firing at such high altitudes is unlikely to generate a strong reaction in birds or bats migrating at lower altitudes or foraging at the surface. While several studies have shown that bats typically fly lower than 10 m above sea level (Ahlén et al., 2009; Pelletier et al., 2013), others have shown that migrating bats have been observed over 200 m above sea level (Hatch et al., 2013; Sjollema et al., 2014). The altitudes at which migrating birds fly can vary greatly based on the type of bird, where they are flying (over water or over land), and other factors such as weather. Approximately 95 percent of bird flight during migrations occurs below 10,000 ft. (3,048 m) with the majority below 3,000 ft. (914 m) (Lincoln et al., 1998). While there is considerable variation, the favored altitude for most small birds appears to be between 500 ft. (152 m) and 1,000 ft. (305 m).

Literature on non-migratory flight altitudes for the four ESA protected species varies in availability. Perkins et al. (2004) found that during the breeding period, most common and roseate terns flew at altitudes below 21 m. The average height from which roseate terns plunge-dive for fish is 4.4 m above the water's surface (Duffy, 1986), and foraging flights rarely, if ever, exceed 12 m in height (Hatch & Kerlinger, 2004; Mostello, 2007). Perkins et al. (2004) recorded most terns (common and roseate) seen in Nantucket Sound (less than 10 mi. offshore) flying at altitudes of less than 30 m. Non-migratory piping plover flight altitude is normally below 120 m, except for courtship flights, which are land-based (U.S. Fish and Wildlife Service, 2008a). Red knot and Bermuda petrel information was not available for non-migratory flight heights.

If a bird or bat does not avoid the area of Navy activity and is in the vicinity of a muzzle blast from a large-caliber gun or the bow shock wave of a large supersonic projectile, the potential for auditory impacts exists. If in the immediate vicinity of a large gun muzzle blast, a bird could experience peak SPLs that have been shown to cause a permanent reduction in hearing sensitivity over the low-frequency portion of hearing range (see Section 3.9.3.1.1.2, Hearing Loss). Similarly, the bow shock waves of larger projectiles would create a zone around the path of the projectile where a bird or bat could experience auditory effects due to the near-instantaneous passing of a high peak pressure wave (subjectively a "crack" sound). The estimated range to peak sound levels shown to cause permanent reduction in hearing sensitivity over a portion of a bird's hearing range from the projectile path of a large-caliber gun projectile travelling at supersonic speed is about 10 m. Data for onset of PTS is unavailable, but the range to onset of PTS can be assumed to extend beyond 10 m from a large-caliber projectile path. The amplitude of the bow shock wave would increase with supersonic projectile size and speed. Because most projectiles spend all or part of their travel path at altitudes above 20 m, impacts to many low-flying seabirds would be minimal.

The impulsive sound caused by weapon firings would have limited potential to mask any important biological sound simply because the duration of the impulse is brief, even when multiple shots are fired in series.

3.9.3.1.7.1 Impacts from Weapons Noise Under Alternative 1

Impacts form Weapons Noise Under Alternative 1 for Training Activities

Activities using weapons and deterrents would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). General characteristics of types of weapons noise are described in Section 3.0.3.3.1.6 (Weapons Noise), and quantities and locations of expended non-explosive practice munitions and explosives (fragment-producing) for training under Alternative 1 are shown in 3.0.3.3.4.2. (Military Expended Materials). (For explosive munitions, only associated firing noise is considered in the analysis of weapons noise. The noise produced by the detonation of explosive weapons is analyzed in Section 3.0.3.3.2, Explosive Stressors).

Use of weapons during training would typically occur in the range complexes, with greatest use of most types of munitions in the Virginia Capes, Navy Cherry Point, and Jacksonville Range Complexes. Most activities involving large-caliber naval gunfire or the launching of targets, missiles, bombs, or other munitions are conducted more than 3 NM from shore.

Most sounds would be brief, lasting from less than a second for a blast or inert impact to a few seconds for other launch and object travel sounds. Most incidents of impulsive sounds produced by weapons firing, launch, or inert object impacts would be single events, with the exception of gunfire activities.

Variants of the Long Range Acoustic Device are used both on vessels and on piers. These devices communicate voice, tones, or prerecorded tracks within the range of human hearing and may reach birds within 3,000 m of the device. Birds have the potential to be briefly startled or temporarily displaced during training with this device, though it is unlikely this device will produce sounds within the hearing range of bats.

Birds and bats that migrate or forage in open ocean areas could be exposed to large-caliber weapons noise, including foraging and migrating Bermuda petrels, migrating roseate terns, and migrating red knots. All species could be exposed to small- and medium-caliber weapons noise that may occur closer to shore. Temporary disturbance due to weapons noise is not expected to result in major impacts on these ESA-listed species. Because large weapons firing would typically occur offshore, roseate tern nesting colonies in the Key West Range Complex are unlikely to be disturbed. Piping plovers would not be present in the offshore areas where weapons are fired; additionally, weapons firing noise would not overlap with piping plover critical habitat.

Because weapon firing occurs at varying locations over a short time period and seabird and bat presence changes seasonally and on a short-term basis, individual birds and bats would not be expected to be repeatedly exposed to weapons firing, launch, or projectile noise. Any impacts on migratory or breeding seabirds and bats related to startle reactions, displacement from a preferred area, or reduced foraging success in offshore waters would likely be short-term and infrequent. Because impacts to individual birds and bats, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Accordingly, there would be no consequences to any bird or bat populations, and weapons noise will not have a significant adverse effect on populations of migratory bird species.

Pursuant to the ESA, weapons noise during training activities described under Alternative 1 will have no effect on piping plover critical habitat. Weapons noise during training activities described under Alternative 1 may affect Indiana bats, northern long-eared bats, piping plovers, Bermuda petrels, roseate terns, and red knots. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Weapons Noise Under Alternative 1 for Testing

Activities using weapons and deterrents would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). General characteristics of types of weapons noise are described in Section 3.0.3.3.1.6 (Weapons Noise), and quantities and locations of expended non-explosive practice munitions and explosives (fragment-producing) for testing under Alternative 1 are shown in 3.0.3.3.4.2. (Military Expended Materials). [For explosive munitions, only associated firing noise is considered in the analysis of weapons noise. The noise produced by the detonation of explosive weapons is analyzed in Section 3.9.3.2 (Explosive Stressors)].

Use of weapons during testing would typically occur on the range complexes, with some activity also occurring on testing ranges. Most activities involving large-caliber naval gunfire or the launching of targets, missiles, bombs, or other munitions are conducted more than 3 NM from shore.

All of these sounds would be brief, lasting from less than a second for a blast or inert impact to few seconds for other launch and object travel sounds. Most incidents of impulsive sounds produced by weapons firing, launch, or inert object impacts would be single events, with the exception of gunfire activities.

Birds and bats that migrate or forage in open ocean areas could be exposed to large-caliber weapons noise, including foraging and migrating Bermuda petrels, migrating roseate terns, and migrating red knots. All species could be exposed to small- and medium-caliber weapons noise that may occur closer to shore. Temporary disturbance due to weapons noise is not expected to result in major impacts on these ESA-listed species. Because large weapons firing would typically occur offshore, roseate tern nesting colonies in the Key West Range Complex are unlikely to be disturbed. Piping plovers would not be present in the offshore areas where weapons are fired; additionally, weapons firing noise would not overlap with piping plover critical habitat.

Because weapon firing occurs at varying locations over a short time period and seabird and bat presence changes seasonally and on a short-term basis, individual birds and bats would not be expected to be repeatedly exposed to weapons firing, launch, or projectile noise. Any impacts on migratory or breeding seabirds and bats related to startle reactions, displacement from a preferred area, or reduced foraging success in offshore waters would likely be short-term and infrequent. Because impacts to individual birds and bats, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Accordingly, there would be no consequences to any bird or bat populations, and weapons noise will not have a significant adverse effect on populations of migratory bird species.

Pursuant to the ESA, weapons noise during testing activities described under Alternative 1 will have no effect on piping plover critical habitat. Weapons noise during testing activities described under Alternative 1 may affect Indiana bats, northern long-eared bats, piping plovers, Bermuda petrels, roseate terns, and red knots. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in that regard.

3.9.3.1.7.2 Impacts from Weapons Noise Under Alternative 2

Impacts from Weapons Noise Under Alternative 2 for Training Activities

There would be minor increase in weapons use under Alternative 2 compared to Alternative 1; however, the types of impacts and locations of impacts would be the same as those described for training under Alternative 1. Because impacts to individual birds or bats, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Accordingly, there would be no consequences to any bird or bat populations, and weapons noise will not have a significant adverse effect on populations of migratory bird species.

Pursuant to the ESA, weapons noise during training activities described under Alternative 2 will have no effect on piping plover critical habitat. Weapons noise during training activities described under Alternative 2 may affect Indiana bats, northern long-eared bats, piping plovers, Bermuda petrels, roseate terns, and red knots.

Impacts from Weapons Noise Under Alternative 2 for Testing Activities

There would be a minor increase in weapons use under Alternative 2 compared to Alternative 1; however, the types and locations of impacts would be the same as those described for testing under Alternative 1. Because impacts to individual birds or bats, if any, are expected to be minor and limited, no long-term consequences to individuals are expected. Accordingly, there would be no consequences to any bird or bat populations, and weapons noise will not have a significant adverse effect on populations of migratory bird species.

Pursuant to the ESA, weapons noise during testing activities described under Alternative 2 will have no effect on piping plover critical habitat. Weapons noise during testing activities described under Alternative 2 may affect Indiana bats, northern long-eared bats, piping plovers, Bermuda petrels, roseate terns, and red knots.

3.9.3.1.7.3 Impacts from Weapons Noise Under No Action Alternative

Impacts from Weapons Noise Under No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the training and testing activities in the AFTT Study Area. Various acoustic stressors (e.g., weapons noise) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.9.3.2 Explosive Stressors

Explosions in the water, near the water surface, and in the air can introduce loud, impulsive, broadband sounds into the marine environment. But, unlike other acoustic stressors, explosives release energy at a high rate producing a shock wave that can be injurious and even deadly. Therefore, explosive impacts to birds and bats are discussed separately from other acoustic stressors, even though the analysis of explosive impacts will rely on data for bird and bat impacts due to impulsive sound exposure where appropriate.

Explosives are usually described by their net explosive weight, which accounts for the weight and type of explosive material. Additional explanation of the acoustic and explosive terms and sound energy concepts used in this section is found in Appendix D (Acoustic and Explosive Concepts).

This section begins with a summary of relevant data regarding explosive impacts to birds and bats in Section 3.9.2.1 (General Background). The ways in which an explosive exposure could result in immediate effects or lead to long-term consequences for an animal are explained in Section 3.0.3.6.1 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Stressors), and this section follows that framework. Studies of the effects of sound and energy from explosives on birds and bats are limited, therefore, where necessary, knowledge of impacts to other species from explosives is used to assess impacts to birds and bats.

3.9.3.2.1 Background

The sections below include a survey and synthesis of best-available-science published in peer-reviewed journals, technical reports, and other scientific sources pertinent to impacts to birds and bats potentially resulting from Navy training and testing activities. A range of impacts could occur to a bird or bat depending on the explosive source and context of the exposure. In addition to acoustic impacts including temporary or permanent hearing loss, auditory masking, physiological stress, or changes in behavior; potential impacts from an explosive exposure can include non-lethal injury and mortality.

3.9.3.2.2 Impacts from Explosives

3.9.3.2.2.1 Injury

If a bird or bat is close to an explosive detonation, the exposure to high pressure levels and sound impulse can cause barotrauma. Barotrauma is physical injury due to a difference in pressure between an air space inside the body and the surrounding air or water. Sudden very high pressures can also cause damage at tissue interfaces due to the way pressure waves travel differently through tissues with different material properties. Damage could also occur to the structure of the ear, considered to be the body part most susceptible to pressure damage. The differences between bird and bat respiratory systems indicate that bats may be more susceptible to pulmonary barotrauma than birds. Birds have compact, rigid lungs with strong pulmonary capillaries that do not change much in diameter when exposed to extreme pressure changes, while bats have large, pliable lungs that expand when exposed to a sudden drop in pressure causing tissue damage. Although the pressure reduction required to cause the type of internal injuries observed in bats is unknown, pressure differences as small as 4.4 kPa are lethal to Norway rats (*Rattus norvegicus*), which has been used as a surrogate species for bat barotrauma studies (Baerwald et al., 2008).

Detonations that occur underwater could injure, kill, or disturb diving birds, particularly pursuit divers that spend more time underwater than other foraging birds (Danil & St Leger, 2011). Studies show that birds are more susceptible to underwater explosions when they are submerged versus partially submerged on the surface. Two species of duck were exposed to explosive blasts while submerged 0.61 m and while sitting on the water surface. Onset of mortality (LD_1) was predicted to occur at an impulse exposure of 248 Pa-s (36 psi-ms) for birds underwater and 690 Pa-s (100 psi-ms) for birds at the water surface (Yelverton & Richmond, 1981). No injuries would be expected for birds underwater at blast pressures below 41 Pa-s (6 psi-msec) and for birds on the surface at blast pressures below 207 Pa-s (30 psi-msec) (Yelverton & Richmond, 1981). Tests of underwater explosive exposures to other taxa (fish, mammals) have shown that susceptibility to injury is related to animal mass, with smaller animals being more susceptible to injury (Yelverton & Richmond, 1981). It is reasonable to assume that this relationship would apply to birds as well. The range to these thresholds would be based on several factors including charge size, depth of the detonation, and how far the bird is beneath the water surface.

Detonations in air or at the water surface could also injure birds or bats while either in flight or at the water surface. Experiments that exposed small, medium, and large birds to blast waves in air were conducted to determine the exposure levels that would be injurious (Damon et al., 1974). Birds were assessed for internal injuries to air sacs, organs, and vasculature, as well as injury to the auditory tympanum, but internal auditory damage was not assessed. Results indicated that peak pressure exposure of 5 psi would be expected to produce no blast injuries, 10 psi would produce slight to extensive injuries, and 20 psi would produce 50 percent mortality. These results also suggested that birds with higher mass may be less susceptible to injury. In addition to the risk of direct blast injury, exposure to an explosion in air may cause physical displacement of a bird that could be injurious if the animal impacts a surface. The same study examined displacement injuries to birds (Damon et al., 1974). Results indicated that impulse exposures below 5 psi-msec would not be expected to result in injuries.

One experiment was conducted with birds in flight, showing how birds can withstand relatively close exposures to in-air explosions (Damon et al., 1974). Flying pigeons were exposed to a 64-lb net explosive weight explosion. Birds at 44 to 126 ft. from the blast exhibited no signs of injury, while serious injuries were sustained at ranges less than 40 ft. The no injury zone in this experiment was also for exposures less than 5 psi-msec impulse, similar to the results of the displacement injury study.

Ranges to the no injury threshold for a range of in-air explosives are shown in Table 3.9-5. Data for birds in this study is assumed to also be applicable to bats due to similar body size.

Table 3.9-5: Range to No Blast Injury for Birds and Bats Exposed to Aerial Explosives

Net explosive weight	*Range to 5 psi*
5 lb.	21 ft.
10 lb.	26 ft.
100 lb.	57 ft.

Notes: Ranges calculated using the methods in U.S. Department of the Navy (1975).

Another risk of explosions in air is exposure to explosive fragmentation, in which pieces of the casing of a cased explosive are ejected at supersonic speeds from the explosion. The risk of direct strike by fragmentation would decrease exponentially with distance from the explosion, as the worst case for strike at any distance is the surface area of the casing fragments, which ultimately would decrease their outward velocity under the influence of drag. It is reasonable to assume that a direct strike in air or at the water surface would be mortal. Once in water, the drag on any fragments would quickly reduce their velocity to non-hazardous levels (Swisdak & Montanaro, 1992).

The initial detonation in a series of detonations may deter birds and bats from subsequent exposures via an avoidance response, however, birds have been observed taking interest in surface objects related to detonation events and subsequently being killed by a following detonation [Stemp, R. in Greene et al. (1985)].

3.9.3.2.2.2 Hearing Loss

Exposure to intense sound may result in hearing loss which persists after cessation of the noise exposure. There are no data on hearing loss in birds or bats specifically due to explosives; therefore, the limited data on hearing loss due to impulsive sounds, described for acoustic stressors in Section 3.9.3.1.1.2 (Hearing Loss), apply to explosive exposures.

3.9.3.2.2.3 Physiological Stress

Birds and bats naturally experience stressors within their environment and as part of their life histories. Changing weather and ocean conditions, exposure to diseases and naturally occurring toxins, lack of prey availability, social interactions with members of the same species, nesting, and interactions with predators all contribute to stress. Exposures to explosives have the potential to provide additional stressors beyond those that naturally occur, as described in Section 3.0.3.6.1 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Stressors).

There are no data on physiological stress in birds or bats specifically due to explosives; therefore, the limited data on physiological stress due to impulsive sounds, described for acoustic stressors in Section 3.9.3.2.2.3 (Physiological Stress), apply to explosive exposures.

3.9.3.2.2.4 Masking

Masking occurs when one sound, distinguished as the 'noise,' interferes with the detection or recognition of another sound. Exposure to explosives may result in masking. There are no data on masking in birds or bats specifically due to explosives; therefore, the limited data on masking due to impulsive sounds, described for acoustic stressors in Section 3.9.3.2.2.4 (Masking), apply to explosive exposures. Due to the very brief duration of an explosive sound, any masking would be brief during an explosive activity.

3.9.3.2.2.5 Behavioral Reactions

Numerous studies have documented that birds and other wild animals respond to human-made noise, including aircraft overflights, weapons firing, and explosions (Larkin et al., 1996; National Park Service, 1994; Plumpton, 2006). The limited data on behavioral reactions to impulsive sounds, described for acoustic stressors in Section 3.9.3.2.2.5 (Behavioral Reactions), apply to explosive exposures.

Because data on behavioral responses by birds and bats to explosions is limited, information on bird and bat responses to other impulsive sounds may be informative. Seismic surveys had no noticeable impacts on the movements or diving behavior of long-tailed ducks undergoing wing molt, a period in which flight is limited and food requirements are high (Lacroix et al., 2003). The birds may have tolerated the seismic survey noise to stay in preferred feeding areas. The sensitivity of birds to disturbance may also vary during different stages of the nesting cycle. Similar noise levels may be more likely to cause nest abandonment during incubation of eggs than during brooding of chicks because birds have invested less time and energy and have a greater chance of re-nesting (Knight & Temple, 1986).

3.9.3.2.2.6 Long-term Consequences

Long-term consequences to birds and bats due to explosive exposures are considered following the Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities (see Section 3.0.3.6.1).

Long-term consequences to a population are determined by examining changes in the population growth rate. Physical effects that could lead to a reduction in the population growth rate include mortality or injury, which could remove animals from the reproductive pool, and permanent hearing impairment, which could impact foraging and communication. The long-term consequences due to individual behavioral reactions and short-term instances of physiological stress are especially difficult to predict because individual experience over time can create complex contingencies. It is more likely that any long-term consequences to an individual would be a result of costs accumulated over a season, year, or life stage due to multiple behavioral or stress responses resulting from exposures to multiple stressors over significant periods of time. Conversely, some birds and bats may habituate to or become tolerant of repeated acoustic exposures over time, learning to ignore a stimulus that in the past did not accompany any overt threat. More research is needed to better understand the long-term consequences of anthropogenic stressors, although intermittent exposures to explosive noise are assumed to be less likely to have lasting consequences.

3.9.3.2.2.7 Impacts from Explosives Under Alternative 1

Impacts from Explosives Under Alternative 1 for Training Activities

Activities using explosives would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). General characteristics, quantities, and net explosive weights of underwater explosives used during training under Alternative 1 are provided in Section 3.0.3.3.2 (Explosive Stressors). Quantities and locations of fragment-producing explosives during training under Alternative 1 are shown in 3.0.3.3.4.2 (Military Expended Materials). Under Alternative 1, there could be fluctuation in the amount of explosives use that could occur annually, although potential impacts would be similar from year to year.

Training activities involving explosions would typically be conducted in the range complexes, with greater occurrence in the Virginia Capes, Jacksonville, Navy Cherry Point, Gulf of Mexico, and Key West Range Complexes, and the lower Chesapeake Bay, although training activities could occur anywhere within the Study Area. Activities that involve underwater detonations and explosive munitions typically occur more than 3 NM from shore however, some mine warfare and demolition activities could also occur in shallow water close to shore. Some surface detonations could occur near areas with the potential for relatively high concentrations of seabirds or bats near the western frontal boundary of the Gulf Stream, including gunnery, bombing, and missile exercises in either Virginia Capes or Navy Cherry Point Range Complexes. Any impacts on seabirds and bats may be greater in these areas. There is no overlap of explosives and piping plover critical habitat.

Sound and energy generated by most small underwater explosions are unlikely to disturb birds and bats above the water surface. If a detonation is sufficiently large or is near the water surface, however, pressure will be released at the air-water interface. Birds and bats above this pressure release could be injured or killed. Explosives detonated at or just above the water surface, such as those used in anti-surface warfare, would create blast waves that would propagate through both the water and air. Detonations in air could also injure birds and bats while either in flight or at the water surface. Detonations in air during anti-air warfare training would typically occur at much higher altitudes (greater than 3,000 ft. [914 m] above sea level) where seabirds, migrating birds, and bats are less likely to be present, although some events target incoming threats at lower altitudes. Detonations of bombs with larger net explosive weight, any event employing static targets, or multiple detonations could be more likely to cause seabird mortalities or injuries. If prey species, such as fish, are killed or injured as a result of detonations, some birds may continue to forage close to the area, or may be attracted to the area and be exposed to subsequent detonations in the same area within a single event, such as gunnery exercises, which involves firing multiple high-explosive 5-in. rounds at a target area; bombing exercises, which could involve multiple bomb drops separated by several minutes; or underwater detonations, such as multiple explosive ordnance disposal charges. However, a fleeing response to an initial explosion may reduce seabird and bat exposure to any additional explosions that occur within a short timeframe.

Detonations either in air or underwater have the potential to cause a permanent or TTS, which could affect the ability of a bird or bat to communicate with conspecifics or detect biologically relevant sounds.

An explosive detonation would likely cause a startle reaction, as the exposure would be brief and any reactions are expected to be short-term. Startle impacts range from altering behavior (e.g., stop feeding or preening), minor behavioral changes (e.g., head turning), or a flight response. The range of impacts could depend on the charge size, distance from the charge, and the animal's behavior at the time of the exposure. Any impacts related to startle reactions, displacement from a preferred area, or reduced foraging success in offshore waters would likely be short-term and infrequent.

Bermuda petrels and roseate terns may be present near the Gulf Stream, where detonations could occur, although little is known about Bermuda petrel distribution. Although Bermuda petrels and roseate terns could be present in range complexes where explosives are used, the likelihood of an injurious exposure is expected to be low based on the limited in-air range of injury from explosions and the expected low density of these birds. Piping plovers may be briefly disturbed in the vicinity of nearshore activities; however, they would not forage or migrate in the open ocean areas where other detonations occur. Red knots could be present during migration over open ocean areas where detonations could occur. If a detonation occurred in the vicinity of migrating red knots, impacts would likely be limited to short-term startle reactions.

Because most events would consist of a limited number of detonations, exposures would not occur over long durations; and since events occur at varying locations, it is expected there would be an opportunity to recover from an incurred energetic cost and individual birds and bats would not be repeatedly exposed to explosive detonations. Indiana bats and northern long-eared bats may be briefly disturbed in the vicinity of nearshore activities, but do not forage or migrate in the open ocean areas where other detonations occur. Although a few individuals may experience long-term impacts and potential mortality, population-level impacts are not expected, and explosives will not have a significant adverse effect on populations of migratory bird species.

Pursuant to the ESA, the use of explosives during training activities described under Alternative 1 will have no effect on piping plover critical habitat. The use of explosives during training activities described under Alternative 1 may affect Bermuda petrels, roseate terns, piping plovers, red knots, Indiana bats, and northern long-eared bats. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in that regard.

Impacts from Explosives Under Alternative 1 for Testing Activities

Activities using explosives would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activity Descriptions). General characteristics, quantities, and net explosive weights of underwater explosives used during training under Alternative 2 are provided in Section 3.0.3.3.2 (Explosive Stressors). Quantities and locations of fragment-producing explosives during training under Alternative 2 are shown in 3.0.3.3.4.2 (Military Expended Materials).

Testing activities involving explosions would typically be conducted in the range complexes, with greater occurrence in the Virginia Capes, Jacksonville, Northeast, Gulf of Mexico, Key West, and Navy Cherry Point Range Complexes, as well as the Naval Surface Warfare Center, Panama City Testing Range. Very few activities would be conducted in the Naval Undersea Warfare Center Division, Newport Testing Range, and the Naval Surface Warfare Center Carderock Division, South Florida Ocean Measurement Facility Testing Range. Small Ship Shock Trials could take place any season within the deep offshore water of the Virginia Capes Range Complex or in the spring, summer or fall within the Jacksonville Range Complex and would occur up to three times over a 5-year period. The Large Ship Shock Trial could take place in the Jacksonville Range Complex during the Spring, Summer, or Fall and during any season within the deep offshore water of the Virginia Capes Range Complex or within the Gulf of Mexico. The Large Ship Shock Trial would occur once over 5 years. Activities that involve underwater detonations and explosive munitions typically occur more than 3 NM from shore; the exception is the designated underwater detonation area near Naval Surface Warfare Center, Panama City Division Testing Range, which is nearshore, partially within the surf zone. Some surface detonations could occur near areas with the potential for relatively high concentrations of seabirds and bats near the western frontal boundary of the Gulf Stream, including firing, bombing, and missile exercises in either Virginia Capes or Navy Cherry Point Range Complexes. Any impacts on seabirds or bats may be greater in these areas. There is no overlap of explosives and piping plover critical habitat. Although testing activities under Alternative 1 differ in number and location from training activities under Alternative 1 and include Ship Shock trials, the types and severity of impacts would not be discernible from those described above in Impacts from Explosives under Alternative 1 for Training Activities.

Sound and energy generated by most small underwater explosions are unlikely to disturb birds and bats above the water surface. If a detonation is sufficiently large or is near the water surface, however, pressure will be released at the air-water interface. Birds and bats above this pressure release could be injured or killed. Explosives detonated at or just above the water surface, such as those used in anti-surface warfare, would create blast waves that would propagate through both the water and air. Detonations in air could also injure birds and bats while either in flight or at the water surface. Detonations in air during anti-air warfare testing would typically occur at much higher altitudes (greater than 3,000 ft. [914 m] above sea level) where seabirds, migrating birds, and bats are less likely to be present, although some events target incoming threats at lower altitudes. Detonations of bombs with larger net explosive weights, any event employing static targets, or multiple detonations could be more likely to cause seabird mortalities or injuries. If prey species, such as fish, are killed or injured as a result of detonations, some birds may continue to forage close to the area, or may be attracted to the area, and be exposed to subsequent detonations in the same area within a single event, such as firing exercises, which involves firing multiple high-explosive 5-in. rounds at a target area; bombing exercises, which could involve multiple bomb drops separated by several minutes; or underwater detonations, such as multiple explosive ordnance disposal charges. However, a fleeing response to an initial explosion may reduce seabird or bat exposure to any additional explosions that occur within a short timeframe.

Detonations either in air or underwater have the potential to cause a permanent or TTS, which could affect the ability of a bird to communicate with conspecifics or detect biologically relevant sounds.

An explosive detonation would likely cause a startle reaction, as the exposure would be brief and any reactions are expected to be short-term. Startle impacts range from altering behavior (e.g., stop feeding or preening), minor behavioral changes (e.g., head turning), or a flight response. The range of impacts could depend on the charge size, distance from the charge, and the animal's behavior at the time of the exposure. Any impacts related to startle reactions, displacement from a preferred area, or reduced foraging success in offshore waters would likely be short-term and infrequent.

Bermuda petrels and roseate terns may be present near the Gulf Stream, where detonations could occur, although little is known about Bermuda petrel distribution. Although Bermuda petrel and roseate tern could be present in range complexes where explosives are used, the likelihood of an injurious exposure is expected to be low based on the limited in-air range of injury from explosions and the expected low density of these birds. Piping plovers may be briefly disturbed in the vicinity of nearshore activities; however, they would not forage or migrate in the open ocean areas where other detonations occur. Red knots could be present during migration over open ocean areas where detonations could occur. If a detonation occurred in the vicinity of migrating red knots, impacts would likely be limited to short-term startle reactions.

Because most events would consist of a limited number of detonations, exposures would not occur over long durations, and events occur at varying locations, it is expected there would be an opportunity to recover from an incurred energetic cost and individual birds and bats would not be repeatedly exposed to explosive detonations. Indiana bats and northern long-eared bats may be briefly disturbed in the vicinity of nearshore activities, but do not forage or migrate in the open ocean areas where other detonations occur. Although a few individuals may experience long-term impacts and potential mortality, population-level impacts are not expected, and explosives will not have a significant adverse effect on populations of migratory bird species. The Navy will implement mitigation to avoid potential impacts on birds during ship shock trials, including ceasing the detonation if flocks of seabirds are observed during the activity, as discussed in Chapter 5 (Mitigation).

Pursuant to the ESA, the use of explosives during testing activities described under Alternative 1 will have no effect on piping plover critical habitat. The use of explosives during testing activities described under Alternative 1 may affect Bermuda petrels, roseate terns, piping plovers, red knots, Indiana bats, and northern long-eared bats . The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in that regard.

3.9.3.2.2.8 Impacts from Explosives Under Alternative 2

Impacts from Explosives Under Alternative 2 for Training Activities

There would be a minor increase in explosives use under Alternative 2 compared to Alternative 1; however, the types and locations of impacts would be the same as those described for training under Alternative 1. Most impacts to individual birds and bats, if any, are expected to be minor and limited. Although a few individuals may experience long-term impacts and potential mortality, population-level impacts are not expected, and explosives will not have a significant adverse effect on populations of migratory bird species.

Pursuant to the ESA, the use of explosives during training activities described under Alternative 2 will have no effect on piping plover critical habitat. The use of explosives during training activities described under Alternative 2 may affect Bermuda petrels, roseate terns, piping plovers, red knots, Indiana bats, and northern long-eared bats.

Impacts from Explosives Under Alternative 2 for Testing Activities

There would be minor increase in explosives use under Alternative 2 compared to Alternative 1; however, the types of impacts and locations of impacts would be the same as those described for testing under Alternative 1. Most impacts to individual birds and bats, if any, are expected to be minor and limited. Although a few individuals may experience long-term impacts and potential mortality, population-level impacts are not expected, and explosives will not have a significant adverse effect on populations of migratory bird species.

Pursuant to the ESA, the use of explosives during testing activities described under Alternative 1 will have no effect on piping plover critical habitat. The use of explosives during testing activities described under Alternative 2 may affect Bermuda petrels, roseate terns, piping plovers, red knots, Indiana bats, and northern long-eared bats.

3.9.3.2.2.9 Impacts from Explosives Under the No Action Alternative

Impacts from Explosives Under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the training and testing activities in the AFTT Study Area. Various explosive stressors would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.9.3.3 Energy Stressors

This section analyzes the potential impacts of the various types of energy stressors that can occur during training and testing activities within the Study Area. This section includes analysis of the potential impacts from (1) in-water electromagnetic devices, (2) in-air electromagnetic devices, and (3) high-energy lasers. As discussed in Section 3.0.3.3.3.3 (Lasers, subsection on Low-Energy Lasers), analysis has shown that low-energy lasers would not affect animals and therefore do not require further analysis.

3.9.3.3.1 Impacts from In-Water Electromagnetic Devices

Several different types of in-water electromagnetic devices are used during training and testing activities. In-water electromagnetic training and testing activities include an array of magnetic measuring components used in mine countermeasure operations in the Study Area. For information on the types of activities that use in-water electromagnetic devices, see Appendix B (Activity Stressor Matrices), Table B-1. For information on where they are used, and how many activities would occur under each alternative, see Section 3.0.3.3.3.1 (In-Water Electromagnetic Devices), Tables 3.0-14 and 3.0-15. Aspects of in-water electromagnetic stressors that are applicable to marine organisms in general are presented in Section 3.0.3.6.2 (Conceptual Framework for Assessing Effects from Energy-Producing Activities). Potential impacts of those activities on birds and bats are applicable to everywhere in the Study Area that in-water electromagnetic devices are used.

The kinetic energy weapon referred to as a rail gun is an in-water electromagnetic device that will be tested and eventually used in training events aboard surface vessels, firing non-explosive projectiles at land- or sea-based targets. This system charges for approximately two minutes and discharges in less than a second. The duration of the firing event is extremely short (about 8 milliseconds), which makes it quite unlikely that a bird or bat would fly over at the precise moment of firing. The short duration of each firing event also means that the likelihood of affecting any animal using magnetic fields for orientation is extremely small. Further, the high magnetic field levels experienced within 80 ft. of the launcher quickly dissipate and return to background levels beyond 80 ft. The magnetic field levels outside of the 80 ft. buffer zone would be below the most stringent guidelines for humans (i.e., people with pacemakers or active implantable medical devices). Therefore, the electromagnetic impacts would be temporary in nature and not expected to result in impacts on organisms (U.S. Department of the Navy, 2009), and are not analyzed further in this section.

Birds are known to use the Earth's magnetic field as a navigational cue during seasonal migrations (Akesson & Hedenstrom, 2007; Fisher, 1971; Haftorn et al., 1988; Wiltschko & Wiltschko, 2005). Birds use numerous other orientation cues to navigate in addition to magnetic fields. These include position of the sun, celestial cues, visual cues, wind direction, and scent (Akesson & Hedenstrom, 2007; Fisher, 1971; Haftorn et al., 1988; Wiltschko & Wiltschko, 2005). It is believed that birds are able to successfully navigate long distances by using a combination of these cues. A magnetite-based (magnetic mineral) receptor mechanism in the upper beak of birds provides information on position and compass direction (Wiltschko & Wiltschko, 2005).Towed in-water electromagnetic device impacts to birds would only occur underwater and would only impact diving species or species on the surface in the immediate area where the device is deployed. There is no information available on how birds react to electromagnetic fields underwater.

Since bats do not dive into water, in-water electromagnetic devices would not affect bats. As such, impacts to bats from in-water electromagnetic devices will not be discussed further.

3.9.3.3.1.1 Impacts from In-Water Electromagnetic Devices Under Alternative 1

Impacts from In-Water Electromagnetic Devices Under Alternative 1 for Training Activities

As indicated in Section 3.0.3.3.3.1 (In-Water Electromagnetic Devices) and Table 3.0-14, and described further in Appendix A (Navy Activity Descriptions), under Alternative 1, training activities involving in-water electromagnetic devices would occur in the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems as well as Gulf Stream Open Ocean Area—specifically within the Virginia Capes, Navy Cherry Point, Jacksonville, and Gulf of Mexico Range Complexes. Use of in-water electromagnetic devices would be concentrated within the Virginia Capes Range Complex. Activities would also occur in one or more of the following bays or inshore waters (Table 3.0-15): Boston, Massachusetts;, Earle, New Jersey; Hampton Roads, Virginia; Delaware Bay, Delaware; Beaufort Inlet Channel, Morehead City, North Carolina; Wilmington, North Carolina; Savannah, Georgia; Kings Bay, Georgia; Mayport, Florida; Port Canaveral, Florida; Tampa, Florida; Sabine Lake, Beaumont, Texas; and Corpus Christi Bay, Corpus Christi, Texas.

The distribution of birds in these portions of the Study Area is patchy (Fauchald et al., 2002; Nevitt & Veit, 1999; Savoca, 2016; Schneider & Duffy, 1985). Exposure of birds would be limited to those foraging at or below the surface (e.g., terns, cormorants, loons, petrels, or grebes) because that is where the devices are used. Birds that forage onshore (e.g., piping plover or red knot) would not be exposed to these in-water electromagnetic stressors because in-water electromagnetic devices are not used in areas close to shore and are used only underwater. Also, the in-water electromagnetic fields generated would be distributed over time and location near mine warfare ranges and harbors, and any influence on the surrounding environment would be temporary and localized. More importantly, the in-water electromagnetic devices used are typically towed by a helicopter, surface ship, or unmanned vehicle. It is likely that any birds in the vicinity of an approaching vehicle towing an in-water electromagnetic device would be dispersed by the sound and disturbance generated by the vehicle (Section 3.9.3.4.1, Impacts from Vessels and In-Water Devices, and Section 3.9.3.4.2, Impacts from Aircraft and Aerial Targets) and therefore move away from the vehicle and device before any exposure could occur.

Designated piping plover critical habitat occurs throughout the coastal habitats of the Southeast U.S. Continental Shelf and Gulf of Mexico Large Marine Ecosystems; however, none of these areas overlap with the use of in-water electromagnetic devices in the Study Area. While piping plovers do forage in the intertidal portions of the Study Area, these areas do not overlap with any locations where in-water electromagnetic devices are used. Therefore, none of the in-water electromagnetic stressors would affect piping plover critical habitat.

Impacts on birds from potential exposure to in-water electromagnetic devices would be temporary and inconsequential based on the: (1) relatively low intensity of the magnetic fields generated (0.2 microtesla at 656 ft. [200 m] from the source), (2) very localized potential impact area,

(3) temporary duration of the activities (hours), (4) occurrence only underwater, and (5) the likelihood that any birds in the vicinity of the approaching vehicles towing an in-water electromagnetic devices would move away from the vehicle and device before any exposure could occur. No long-term or population-level impacts are expected.

Pursuant to the ESA, the use of in-water electromagnetic devices during training activities as described under Alternative 1 would have no effect on Indiana bats, northern long-eared bats, piping plovers, red knots, or piping plover critical habitat; but may affect Bermuda petrels and roseate terns. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in this regard.

Impacts from In-Water Electromagnetic Devices Under Alternative 1 for Testing Activities

As indicated in Section 3.0.3.3.3.1 (In-Water Electromagnetic Devices) and Table 3.0-14, under Alternative 1, testing activities involving in-water electromagnetic devices would occur in the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems as well as Gulf Stream Open Ocean Area—specifically within the Virginia Capes, Navy Cherry Point, Jacksonville, and Gulf of Mexico Range Complexes as well as the Naval Undersea Warfare Center Newport Testing Range, Naval Surface Warfare Center Carderock Division's South Florida Ocean Measurement Facility, and Naval Surface Warfare Center Panama City Testing Range. Activities using in-water electromagnetic devices would be concentrated within the Naval Undersea Warfare Center Newport Testing Range. Activities would also occur in the inshore waters at Little Creek, Virginia (Table 3.0-15).

Birds that forage on shore (e.g., piping plover or red knot) would not be exposed to these in-water electromagnetic stressors because in-water electromagnetic devices are not used in areas close to shore and are only used underwater. As mentioned in the training activities discussion above, it is likely that any birds in the vicinity of an approaching vehicle towing an in-water electromagnetic device would be dispersed by the sound and disturbance generated by the vehicle (Section 3.9.3.4.1, Impacts from Vessels and In-Water Devices, and Section 3.9.3.4.2, Impacts from Aircraft and Aerial Targets) and would therefore move away from the vehicle and device before any exposure could occur. Although designated piping plover critical habitat occurs throughout the coastal habitats of the Southeast U.S. Continental Shelf and Gulf of Mexico Large Marine Ecosystems, none of these areas overlap with the use of in-water electromagnetic devices in the Study Area. Therefore, for reasons stated in the training activities, no long-term or population-level impacts to birds are expected and none of the in-water electromagnetic stressors will affect piping plover critical habitat.

Pursuant to the ESA, the use of in-water electromagnetic devices during testing activities as described under Alternative 1 would have no effect on Indiana bats, northern long-eared bats, or piping plover critical habitat; but may affect Bermuda petrels, piping plovers, roseate terns, and red knots. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in this regard.

3.9.3.3.1.2 Impacts from In-Water Electromagnetic Devices Under Alternative 2

Impacts from In-Water Electromagnetic Devices Under Alternative 2 for Training Activities

The number and distribution of training activities using in-water electromagnetic devices under Alternative 2 would be the same as under Alternative 1 (Tables 3.0-14 and 3.0-15); therefore, the impacts would be the same as for Alternative 1.

Pursuant to the ESA, the use of in-water electromagnetic devices during training activities as described under Alternative 2 would have no effect on Indiana bats, northern long-eared bats, or piping plover critical habitat; but may affect Bermuda petrels, piping plovers, roseate terns, and red knots.

Impacts from In-Water Electromagnetic Devices Under Alternative 2 for Testing Activities

The number and distribution of testing activities using in-water electromagnetic devices under Alternative 2 would be the same as for Alternative 1 (Tables 3.0-14 and 3.0-15); therefore, impacts would be the same as for Alternative 1.

Pursuant to the ESA, the use of in-water electromagnetic devices during testing activities as described under Alternative 2 would have no effect on Indiana bats, northern long-eared bats, or piping plover critical habitat; but may affect Bermuda petrels, piping plovers, roseate terns, and red knots.

3.9.3.3.1.3 Impacts from In-Water Electromagnetic Devices Under the No Action Alternative

Impacts from In-Water Electromagnetic Devices Under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various energy stressors (e.g., in-water electromagnetic devices) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.9.3.3.2 Impacts from In-Air Electromagnetic Devices

Several different types of in-air electromagnetic devices are used during training and testing activities, including an array of communications transmitters, radars, and electronic countermeasures transmitters. For information on the types of activities that use in-water electromagnetic devices, see Appendix B (Activity Stressor Matrices), Table B-1. For a information on where they are used, and how many activities would occur under each alternative, see Section 3.0.3.3.3.2 (In-Air Electromagnetic Devices). Aspects of in-air electromagnetic stressors that are applicable to marine organisms in general are presented in Section 3.0.3.6.2 (Conceptual Framework for Assessing Effects from Energy-Producing Activities).

As discussed in Section 3.0.3.3.3.2 (In-Air Electromagnetic Devices), most of the transmissions from in-air electromagnetic devices (e.g., for routine surveillance, communications, and navigation) will be at low power. Based on human standards, high-power in-air electromagnetic devices are those that produce peak pulses of 200 kilovolts per meter in a single pulse (U.S. Department of Defense, 2009); there are no federal standards for electromagnetic radiation exposure on wildlife (Manville, 2016; U.S. Department of Defense, 2009). In-air electromagnetic devices can also be characterized as “near-field” or “far-field” (i.e., near to, or far from, the source of electromagnetic radiation).

Studies conducted on in-air electromagnetic sensitivity in birds have typically been associated with land, and little information exists specifically on seabird response to in-air electromagnetic changes at sea. Based on these studies, in-air electromagnetic effects can be categorized as thermal (i.e., capable of causing damage by heating tissue) or non-thermal. Thermal effects are most likely to occur when near high-power systems. Should such effects occur, they would likely cause birds and bats to temporarily avoid the area receiving the electromagnetic radiation until the stressor ceases (Ahlén et al., 2009; Manville, 2016; Nicholls & Racey, 2007, 2009). For example, studies have found that bat activity and foraging effort is substantially reduced in the vicinity of radar (Ahlén et al., 2009; Nicholls & Racey, 2007, 2009). Heat energy produced during flight makes bats susceptible to overheating, and (Nicholls & Racey, 2007); Nicholls and Racey (2009) theorize that the large surface area of bats’ wing membranes may absorb electromagnetic radiation, thereby increasing the risk of hyperthermia and causing bats to avoid sources of electromagnetic radiation.

Currently, questions exist about far-field, non-thermal effects from low power, in-air electromagnetic devices. Manville (2016) performed a literature review of this topic. Although findings are not always consistent, Manville (2016) reported that several peer-reviewed studies have shown non-thermal effects can include (1) affecting behavior by preventing birds from using their magnetic compass, which may in turn affect migration; (2) fragmenting the DNA of reproductive cells, decreasing the reproductive capacity of living organisms; (3) increasing the permeability of the blood-brain barrier; (4) other behavioral effects; (5) other molecular, cellular, and metabolic changes; and (6) increasing cancer risk.

Cucurachi et al. (2013) also performed a literature review of 113 studies and reported that (1) few field studies were performed (the majority were conducted in a laboratory setting); (2) 65% of the studies reported ecological effects both at high as well as low dosages (i.e., those that are compatible with real field situations, at least on land); (3) no clear dose-effect relationship could be discerned but that studies finding an effect applied higher durations of exposure and focused more on mobile phone frequency ranges; and (4) a lack of standardization and a limited number of observations limited the possibility of generalizing results from an organism to an ecosystem level.

Many bird species return to the same stopover, wintering, and breeding areas every year and often follow the exact same or very similar migration routes (Akesson, 2003; Alerstam et al., 2006), and ample evidence exists that displaced birds can successfully reorient and find their way when one or more cues are removed (Akesson, 2003; Haftorn et al., 1988). For example, Haftorn et al. (1988) found that after removal from their nests and release into a different area, snow petrels (*Pagodrama nivea*) were able to successfully navigate back to their nests even when their ability to smell was removed. Furthermore, Wiltschko and Wiltschko (2005) report that in-air electromagnetic pulses administered to birds during an experimental study on orientation do not deactivate the magnetite-based receptor mechanism in the upper beak altogether but instead cause the receptors to provide altered information, which in turn causes birds to orient in different directions. However, these impacts were temporary, and the ability of the birds to correctly orient themselves eventually returned. Similar results were found by a subsequent study by Wiltschko et al. (2011) on European robins (*Erithacus rubecula*) that tested the effects of exposure to specific wavelengths of visible light. Therefore, in the unlikely event that a bird is temporarily disoriented by an electromagnetic device, it is expected that it would still be able to reorient using its internal magnetic compass to aid in navigation once the stressor ceases or the bird and stressor are separated by sufficient distance. Therefore, any temporary disorientation experienced by birds from electromagnetic changes caused by training activities in the Study Area may be considered a short-term impact and would not hinder bird navigation abilities. Furthermore, other orientation cues may include position of the sun and moon, visual cues, wind direction, infrasound, and scent; these cues would not be affected by in-air electromagnetic devices.

The Environmental Assessment for the Upgraded AEGIS Combat System concluded that the rapid increase of the bird population around a newly constructed radar installation "indicates that any negative effects of the radiation zone overhead have been negligible." Another study on the impacts of extremely low-frequency in-air electromagnetic fields on breeding and migrating birds around the Navy's extra-low-frequency communication system antenna in Wisconsin found no evidence that bird distribution or abundance was impacted by in-air electromagnetic fields produced by the antenna. In addition, radars, including X-band systems, are frequently used to track bird movements as it has been demonstrated that they do not affect bird behavior. Moreover, previous studies have consistently determined that the chances that a bird or bat will move in the same direction and at the same speed as a constant beam of electromagnetic radiation (e.g., while an in-air electromagnetic device tracks a target), and therefore be exposed to radiation that could cause thermal damage, are extremely small.

Studies have found that bat activity and foraging effort is substantially reduced in the vicinity of radar (Ahlén et al., 2009; Nicholls & Racey, 2007, 2009). Heat energy produced during flight makes bats susceptible to overheating, and Nichols & Racey theorize that the large surface area of bats' wing membranes may absorb electromagnetic radiation, thereby increasing the risk of hyperthermia and causing bats to avoid sources of electromagnetic radiation (Nicholls & Racey, 2007, 2009). As such, bats may temporarily avoid the general vicinity where training or testing activities that generate in-air electromagnetic radiation and the potential to for in-air electromagnetic radiation to injure a bat is negligible. Given the infrequent and seasonal use of the Study Area by bats (Section 3.9.2.1.2, Habitat Use), the localized nature of the area affected by in-air electromagnetic radiation, and that impacts would be limited to temporary behavioral responses and displacement from the affected area, few, if any, individual bats would be affected, and exposure would not have persistent or accumulating effects.

Given (1) the information provided above; (2) the dispersed nature of Navy testing and training activities at sea; and (3) the relatively low-level and dispersed use of these systems at sea, the following conclusions are reached:

1. The chance that in-air electromagnetic devices would cause thermal damage to an individual bird or bat is extremely low;
2. It is possible, although unlikely, that some bird or bat individuals would be exposed to levels of electromagnetic radiation that would cause discomfort, in which case they would likely avoid the immediate vicinity of testing and training activities;
3. The strength of any avoidance response would decrease with increasing distance from the in-air electromagnetic device; and
4. No long-term or population-level impacts would occur.

3.9.3.3.2.1 Impacts from In-Air Electromagnetic Devices Under Alternative 1

Impacts from In-Air Electromagnetic Devices Under Alternative 1 for Training Activities

As indicated in Section 3.0.3.3.3.2 (In-Air Electromagnetic Devices) and Tables 3.0-18 and 3.0-37, under Alternative 1, training activities involving in-air electromagnetic devices would occur throughout the Study Area but would be concentrated in the Virginia Capes Range Complex, Navy Cherry Point Range Complex, Jacksonville Range Complex, and inshore waters. For the reasons described above, however, no long-term or population-level impacts to birds or bats would occur.

Pursuant to the ESA, the use of in-air electromagnetic devices during training activities as described under Alternative 1 would have no effect on piping plover critical habitat, but may affect Bermuda petrels, piping plovers, roseate terns, red knots, Indiana bats, and northern long-eared bats. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in this regard.

Impacts from In-Air Electromagnetic Devices Under Alternative 1 for Testing Activities

As indicated in Section 3.0.3.3.3.2 (In-Air Electromagnetic Devices) and Tables 3.0-18 and 3.0-37, under Alternative 1, testing activities involving in-air electromagnetic devices would occur throughout the Study Area but would be concentrated in the Northeast Range Complexes, Virginia Capes Range Complex, Navy Cherry Point Range Complex, Jacksonville Range Complex, and Naval Undersea Warfare

Center Newport Testing Range. For the reasons described above, however, no long-term or population-level impacts to birds or bats would occur.

Pursuant to the ESA, the use of in-air electromagnetic devices during testing activities as described under Alternative 1 would have no effect on piping plover critical habitat, but may affect Bermuda petrels, piping plovers, roseate terns, red knots, Indiana bats, and northern long-eared bats. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in this regard.

3.9.3.3.2.2 Impacts from In-Air Electromagnetic Devices Under Alternative 2

Impacts from In-Air Electromagnetic Devices Under Alternative 2 for Training Activities

The number and distribution of training activities using in-air electromagnetic devices under Alternative 2 would differ slightly from Alternative 1 insofar as the average number of total vessel and aircraft activities within the Study Area would increase slightly (by approximately 1.0 percent for vessel activities, and a fraction of a percent for aircraft activity) over a 5-year period (Tables 3.0-18 and 3.0-37, respectively). Given the foregoing analysis, this difference is inconsequential and the impacts would be essentially the same as for Alternative 1.

Pursuant to the ESA, the use of in-air electromagnetic devices during training activities as described under Alternative 2 would have no effect on piping plover critical habitat, but may affect Bermuda petrels, piping plovers, roseate terns, red knots, Indiana bats, and northern long-eared bats.

Impacts from In-Air Electromagnetic Devices Under Alternative 2 for Testing Activities

The number and distribution of testing activities using in-air electromagnetic devices under Alternative 2 would differ slightly from Alternative 1 insofar as the average number of total vessel and aircraft activities within the Study Area would increase slightly (by approximately 1.1 percent for both vessel and aircraft activity) over a 5-year period (Tables 3.0-18 and 3.0-37, respectively). The majority of the increase in activity would occur at the Virginia Capes Range Complex. Given the foregoing analysis, this difference is inconsequential and the impacts would be essentially the same as for Alternative 1.

Pursuant to the ESA, the use of in-air electromagnetic devices during testing activities as described under Alternative 2 would have no effect on piping plover critical habitat, but may affect Bermuda petrels, piping plovers, roseate terns, red knots, Indiana bats, and northern long-eared bats.

3.9.3.3.2.3 Impacts from In- Air Electromagnetic Devices Under the No Action Alternative

Impacts from In- Air Electromagnetic Devices Under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various energy stressors (e.g., in-air electromagnetic devices) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.9.3.3.3 Impacts from High-Energy Lasers

This section analyzes the potential impacts of high-energy lasers on birds and bats. As discussed in Section 3.0.3.3.3.3 (Lasers), high energy laser weapons are designed to disable targets, rendering them immobile. The primary concern is the potential for a bird or bat to be directly struck with the laser beam, which could result in injury or death, depending on the wavelength of the laser and where and for how long the beam contacts the animal. Tissue damage results primarily from thermal effects of the radiation. The eyes and areas of thin, exposed skin are the tissues most susceptible to damage from lasers.

Birds or bats could be exposed to a laser only if they fly through the beam at the instant the laser is fired. This has a very low probability of occurrence because of the limited use of high-energy lasers in the Study Area and the fact that the energy of the laser is concentrated within a very small area for only a few seconds. For a bird or bat in flight – the circumstance under which contact with a laser beam is most likely, the possibility that parts of the animal most susceptible to damage, especially the eyes, would cross the beam is remote.

3.9.3.3.3.1 Impacts from High-Energy Lasers Under Alternative 1

Impacts from High-Energy Lasers Under Alternative 1 for Training Activities

Under Alternative 1, training activities using high-energy lasers would occur 4 times per year at the Virginia Capes and Jacksonville Range Complexes (Table 3.0-16). ESA-listed bird and bat species that could occur in these areas include the Bermuda petrel, piping plover, roseate tern, red knot, Indiana bat, and northern long-eared bat. The likelihood of a bird or bat crossing the laser beam at the instant the laser is fired is extremely remote but possible.

No long-term or population-level impacts are expected. Neither birds nor bats are likely to be exposed to high energy lasers based on the: (1) relatively low number of activities, (2) very localized potential impact area of the laser beam, and (3) temporary duration of potential impact (seconds). The likelihood that an ESA-listed bird or bat species would be struck by a high-energy laser beam is so small as to be discountable; no impacts to ESA-listed species are anticipated.

Pursuant to the ESA, the use of high-energy lasers during training activities as described under Alternative 1 would have no effect on piping plover critical habitat, piping plovers, or red knots; but may affect Bermuda petrels, roseate terns, Indiana bats, and northern long-eared bats. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in this regard.

Impacts from High-Energy Lasers Under Alternative 1 for Testing Activities

High-energy laser testing activities would occur predominantly in the Virginia Capes Range Complex, and to a lesser degree at other Navy range complexes and facilities (Northeast Range Complexes, Navy Cherry Point Range Complex, Jacksonville Range Complex, Key West Range Complex, Gulf of Mexico Range Complex, Naval Undersea Warfare Center Newport Testing Range, Naval Surface Warfare Center Carderock Division's South Florida Ocean Measurement Facility, and Naval Surface Warfare Center Panama City Testing Range), although not in the inshore waters, within the Study Area (Table 3.0-16). The likelihood of a bird or bat crossing the laser beam at the instant the laser is fired is extremely remote but possible.

No long-term or population-level impacts are expected. Neither birds nor bats are likely to be exposed to high energy lasers based on the: (1) relatively low number of activities, (2) very localized potential impact area of the laser beam, and (3) temporary duration of potential impact (seconds). The likelihood that an ESA-listed bird or bat species would be struck by a high-energy laser beam is so small as to be discountable; no impacts to ESA-listed species are anticipated.

Pursuant to the ESA, the use of high-energy lasers during testing activities as described under Alternative 1 would have no effect on piping plover critical habitat, piping plovers, or red knots; but may affect Bermuda petrels, roseate terns, Indiana bats, and northern long-eared bats. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in this regard.

3.9.3.3.3.2 Impacts from High-Energy Lasers Under Alternative 2

Impacts from High-Energy Lasers Under Alternative 2 for Training Activities

The use of high energy lasers under Alternative 2 for training activities would be the same as under Alternative 1 (Table 3.0-16); therefore, impacts would be the same.

Pursuant to the ESA, the use of high-energy lasers during training activities as described under Alternative 2 would have no effect on piping plover critical habitat, piping plovers, or red knots; but may affect Bermuda petrels, roseate terns, Indiana bats, and northern long-eared bats.

Impacts from High-Energy Lasers Under Alternative 2 for Testing Activities

The use of high-energy lasers under Alternative 2 for testing activities would be the same as under Alternative 1 (Table 3.0-16); therefore, impacts would be the same.

Pursuant to the ESA, the use of high-energy lasers during testing activities as described under Alternative 2 would have no effect on piping plover critical habitat, piping plovers, or red knots; but may affect Bermuda petrels, roseate terns, Indiana bats, and northern long-eared bats.

3.9.3.3.3.3 Impacts from High-Energy Lasers Under the No Action Alternative

Impacts from High-Energy Lasers Under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various energy stressors (e.g., high-energy lasers) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.9.3.4 Physical Disturbance and Strike Stressors

This section describes the potential impacts to birds and bats by aircraft and aerial target strikes, vessels (disturbance and strike), and military expended material strike. For a list of Navy activities that involve this stressor refer to Appendix B (Activity Stressor Matrices). Aircraft include fixed-wing and rotary-wing aircraft; vessels include various sizes and classes of ships, and other boats; in-water devices include devices that are towed, unmanned surface, and underwater vehicles; military expended materials include non-explosive practice munitions, target fragments, decelerators/parachutes, and other objects.

Physical disturbance and strike risks, primarily from aircraft, have the potential to impact all taxonomic groups found within the Study Area (Table 3.9-1). In addition to the potential for injury and mortality, impacts of physical disturbance include behavioral responses such as temporary disorientation, change in flight direction, and avoidance response behavior. Physical disturbances (discussed in Section 3.9.3.4.2, Impacts from Aircraft and Aerial Targets) may elicit short-term behavioral or physiological responses in birds or bats such as alert response, startle response, cessation of feeding, fleeing the immediate area, and a temporary increase in heart rate. These disturbances can also result in abnormal behavioral, growth, or reproductive impacts in nesting birds and can cause foraging and nesting birds to flush from or abandon their habitats or nests (Andersen et al., 1989; Komenda-Zehnder et al., 2003). Aircraft strikes often result in bird or bat mortalities or injuries (Dolbeer, 2006).

Although birds and bats likely hear and see approaching vessels and aircraft, they cannot avoid all collisions. Nighttime lighting on vessels, specifically high-powered searchlights used for navigation in icy waters off of Greenland, has caused birds to become confused and collide with naval vessels, cargo vessels, and trawlers (Gehring et al., 2009; Merkel & Johansen, 2011; Poot et al., 2008). Bats are also known to collide with buildings and communication towers (Cryan & Brown, 2007; Hatch et al., 2013) and therefore may also collide with vessels. Collisions with vessels can result in bird or bat mortalities or injuries.

3.9.3.4.1 Impacts from Vessels and In-Water Devices

Vessels

The majority of the training and testing activities in the Study Area involve vessels. For a discussion of the types of vessels used as well as the number and location of activities that include vessels under each alternative, see Section 3.0.3.3.4.1 (Vessels and In-Water Devices). Table 3.0-17 provides representative vessel types and their sizes and typical operating speeds; Table 3.0-18 provides the number and locations of activities that include vessels; Table 3.0-19 provides the number and location of activities in inshore waters that include vessels; and Table 3.0-20 provides the location and annual number of high speed vessel hours for small crafts in inshore waters. Appendix B (Activity Stressor Matrices) provides the types of activities that use vessels.

Potential impacts of those activities on birds and bats are applicable to everywhere in the Study Area that vessels are used. Training and testing activities within the Study Area involve maneuvers by various types of surface ships, boats, and submarines. The number of Navy ships and smaller vessels in the Study Area varies based on training and testing schedules. Activities involving vessel movements occur intermittently, ranging from a few hours to a few weeks. Events involving large vessels are widely spread over the open ocean, while smaller vessels are more active and more concentrated in nearshore areas.

Direct collisions with most Navy vessels (or a vessel's rigging, cables, poles, or masts) are unlikely but may occur, especially at night. Lighting on boats and vessels has also contributed to bird fatalities in open ocean environments when birds are attracted to these lights, usually in inclement weather conditions (Merkel & Johansen, 2011). Birds can become disoriented at night in the presence of artificial light (Favero et al., 2011; Hamilton, 1958; Hyrenbach, 2001, 2006), and lighting on vessels may attract some birds, increasing the potential for harmful encounters. Other impacts to birds would be the visual and behavioral disturbance from a vessel. Birds respond to moving vessels in various ways. Some birds, including certain species of gulls, storm petrels, and albatrosses, commonly follow vessels; while other species such as plovers, curlews, frigatebirds, and sooty terns seem to avoid vessels (Borberg et al., 2005; Hyrenbach, 2006). There could be a slightly increased risk of impacts during the winter, or fall/spring migrations when migratory birds use celestial clues during night time flight and are concentrated in coastal areas. However, despite this concentration, most birds would still be able to avoid collision with a vessel. Vessel movements could elicit short-term behavioral or physiological responses (e.g., alert response, startle response, fleeing the immediate area, temporary increase in heart rate).

Navy aircraft carriers, surface combatant vessels, and amphibious warfare ships are minimally lighted for tactical purposes. For vessels of this type there are two white lights that shine forward and one that shines aft; these lights must be visible for at least 6 NM. A single red and a single green light are located on the port and starboard sides of vessels, respectively. These lights are visible for a minimum of 3 NM. Solid white lighting appears more problematic for birds, especially nocturnal migrants (Gehring et al., 2009; Poot et al., 2008). Navy vessel lights are mostly solid, but sometimes may not appear solid because of the constant movement of the vessel (wave action), making vessel lighting potentially less problematic for birds in some situations.

Cryan and Brown (2007) suggested that bats may be attracted to tall and highly visible landmarks (e.g., crowns of trees, islands, and wind turbines), and Thompson et al. (2015) provided anecdotal evidence that a flock of *Myotis* sp. may temporarily roost overnight on a fishing vessel at sea. To date, however, no studies have suggested that bats are attracted to ships at sea. Regardless, since bats (especially migratory bats) are known to collide with buildings and communication towers (Cryan & Brown, 2007; Hatch et al., 2013), and insects (which bats in the Study Area prey upon) can be attracted to ships at sea during certain weather conditions (Ahlén et al., 2009), it is possible that bats may collide with naval vessels at sea. However, the likelihood that this could occur is considered low given the infrequent, seasonal use of the Study Area by bats and that bats may be deterred from getting too close to naval vessels by behavioral responses to in-air electromagnetic devices (refer to Section 3.9.3.3.2, Impacts from In-Air Electromagnetic Stressors).

While some potential exists for birds or bats to be struck by vessels as they are foraging, resting, or flying near the water surface, most birds and bats would be expected to see or hear an oncoming vessel and to fly or swim away to avoid a potentially harmful encounter. Injury or mortality could occur if a bird or bat were struck, but most bird or bat encounters with vessels would be expected to result in a brief behavioral and physiological response as described above. It should be noted that such responses involve at the least a temporary displacement of birds or bats (to a lesser degree, since bats are most active from dusk to dawn) from foraging areas, resulting in energetic costs to the animals. Birds and bats would be expected to return and resume foraging soon after the vessel passed through the area, or to forage elsewhere, and the fitness of individual animals would probably not be compromised.

Other harmful bird-vessel interactions are commonly associated with commercial fishing vessels because birds are attracted to concentrated food sources around these vessels. However, these concentrated food sources are not associated with Navy vessels, so birds following Navy vessels would be very unlikely.

Amphibious vessel movements could elicit short-term behavioral or physiological responses such as alert response, startle response, cessation of feeding, fleeing the immediate area, nest abandonment, and a temporary increase in heart rate. There could be a slightly increased risk of impacts during the winter, or fall/spring migrations and during the nesting season when migratory birds or bats are concentrated in coastal areas where amphibious vessels have the potential to disturb nesting or foraging shorebirds or foraging or migrating bats. The general health of individual birds or bats would not be compromised, unless a direct strike occurred. However, it is highly unlikely that a bird or bat would be struck in this scenario because most foraging shorebirds and bats in the vicinity of the approaching amphibious vessel would likely be dispersed by the sound of its approach before it could come close enough to strike a bird or bat (Section 3.9.3.1.5, Impacts from Vessel Noise).

Large vessel movement primarily occurs within the U.S. Exclusive Economic Zone, with the majority of the traffic flowing in a direct line between Naval Stations Norfolk and Mayport. There would be a higher likelihood of vessel strikes over the continental shelf portions than in the open ocean portions of the Study Area because of the concentration of vessel movements in those areas. Even in areas of concentrated vessel use, the probability of bird/vessel or bat/vessel interaction is low because of the high mobility of birds and bats, and because bats are most active from dusk to dawn and are unlikely to be found in open ocean areas.

Under a worst-case scenario, vessel movements could cause the localized, temporary movement of birds or bats to areas that are less desirable, resulting in some energetic cost which may or may not be important to an individual's survival and reproduction. However, it is unlikely that impacts would occur to the point that birds or bats would be permanently displaced from important habitats that were not already subject to heavy ongoing use. As such, no long-term or population-level impacts are expected.

In-Water Devices

Section 3.0.3.3.4.1 (Vessels and In-water Devices) provides information on the types, sizes and speeds of in-water devices, and Table 3.0-22 provides the locations where they would be used. For a list of activities by name that include the use of in-water devices, see Appendix B (Activity Stressor Matrices). In-water devices include surface and underwater unmanned vehicles, torpedoes and towed devices, and their use occurs virtually throughout the Study Area.

As discussed in Section 3.0.3.3.4.1 (Vessels and In-water Devices), these devices are self-propelled and unmanned or towed through the water from a variety of platforms, including helicopters, unmanned underwater vehicles, and surface ships. In-water devices are generally smaller than most Navy vessels, ranging from several in. to about 50 ft. These devices can operate anywhere from the water surface to the benthic zone. Most of these devices do not have a realistic potential to strike living marine resources because they either move slowly through the water column (e.g., most unmanned undersea vehicles) or are closely monitored by observers manning the towing platform (e.g., most towed devices) who ensure the towed in-water device does not run into objects in the water. Unmanned surface vehicles, because of their size and potential operating speed, have the potential to strike living marine resources. Unmanned surface vehicles are remotely operated, fast-moving, agile vehicles that may operate at speeds up to 50+ knots (Table 3.0-21), thus the potential for disturbance exists. The likelihood of a strike, however is very low because they are operated only in conditions of good visibility.

Mine warfare devices that are towed through the water (or the aircraft and cables that connect the aircraft to the device) and remotely operated underwater vehicles used during mine neutralization training and testing could also strike seabirds or bats. No documented instances of seabirds or bats being struck by towed devices have occurred in the Study Area. Additionally, based on the low altitudes and relatively slow air speeds, seabirds and bats would be able to detect and avoid the aircraft and cables that connect the aircraft to the towed device.

3.9.3.4.1.1 Impacts from Vessels and In-Water Devices Under Alternative 1

<u>Impacts from Vessels and In-Water Devices Under Alternative 1 for Training Activities</u>

Vessels

The potential for interaction is greater in coastal areas than pelagic areas where Navy vessel use is less concentrated. However, even in areas of concentrated vessel use, the probability of seabird/vessel or bat/vessel interaction is low because the high mobility of seabirds and bats allows them to move away from an oncoming vessel. Flushing of birds is expected to be greatest when vessels, towed devices, and unmanned surface vehicles are operated at relatively high speeds (as described in Tables 3.0-17 through 3.0-23). While such flushing or other impacts of vessels on individual birds may occur, and bats may be temporarily displaced from a foraging area, none of these temporary impacts are expected to have an impact on the long-term fitness of individual birds or bats or have population-level impacts.

Amphibious vessels and especially amphibious landings could potentially impact bird species, specifically shorebirds that nest and forage along the shoreline. These activities also have a greater probability of temporarily displacing bats from foraging in these areas, since bats are forage more frequently near land than in open ocean areas in the Study Area. Amphibious landings would occur at traditionally used beaches in the Virginia Capes, Navy Cherry Point, and Jacksonville Range Complexes (Table 2.3-3). The ESA-listed species that would be potentially impacted at these locations would be piping plover, roseate tern, red knot, and northern long-eared bat.

The locations where amphibious landing activities occur at Onslow Beach and Seminole Beach are not considered optimal habitat for piping plovers (U.S. Fish and Wildlife Service, 2009b). Piping plovers have been documented foraging within the intertidal shoreline at Onslow Beach and Seminole Beach during the winter, spring, and fall migration periods and during the nesting season, although no nests have been found to date (U.S. Fish and Wildlife Service, 2009b). Roseate terns and red knots could use these beaches as a resting area and could be found foraging in the waters near the beach. Northern long-eared bats could use these beaches as foraging areas during spring and fall migration. While they could be present, it is highly unlikely that a piping plover, roseate tern, red knot, or northern long-eared bat would be struck in this scenario because most foraging or resting shorebirds, or foraging bats, in the vicinity of the approaching amphibious vessel would likely be dispersed by the sound of its approach before it could come close enough for a collision to take place (Section 3.9.3.1.6, Impacts from Aircraft Noise). Furthermore, Marine Corps Base Camp Lejeune, and Naval Station Mayport have specific Integrated Natural Resource Management Plans for addressing ESA-listed bird species, and those plans already include project avoidance and minimization actions that reduce threats from military activities to wintering and migrating piping plovers to a minimal level (U.S. Fish and Wildlife Service, 2009b).

There is no overlap of vessels with designated critical habitat for piping plover. Additionally no critical habitat is designated at Onslow Beach or Seminole Beach. However, critical habitat does exist on the opposite (north) side of the St. Johns River from Seminole Beach. This area of critical habitat is outside the boundary of the Study Area. No long-term or population-level impacts are expected.

In-Water Devices

In-water devices used are typically towed by a boat or helicopter, unmanned vehicles or fired from a ship. As discussed for electromagnetic devices (Section 3.9.3.3.2, Impacts from In-Air Electromagnetic Devices), it is likely that any birds or bats in the vicinity of the approaching boat, helicopter, unmanned vehicle or ship firing torpedoes would be dispersed by their sound (Section 3.9.3.1.6, Impacts from Aircraft Noise) and move away from the in-water device before any exposure could occur. Therefore, the use of in-water devices is expected to have only short-term impacts on individual birds and bats, with very low potential for injury or mortality, and no population-level impacts.

Pursuant to the ESA, the use of vessels and in-water devices during training activities as described under Alternative 1 would have no effect on piping plover critical habitat, but may affect Bermuda petrels, piping plovers, roseate terns, red knots, Indiana bats, and northern long-eared bats. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in this regard.

Impacts from Vessels and In-Water Devices Under Alternative 1 for Testing Activities

As indicated in Section 3.0.3.3.4.1 (Vessels and In-Water Devices), Navy vessel and in-water activities associated with testing activities would be fewer than those associated with training. While there is considerable overlap between training and testing activities, test activities would occur more frequently in established test areas that are relatively closer to shore, including the Newport and Panama City Testing Ranges and South Florida Ocean Measurement Facility (Tables 3.10-17 through 3.0-23).

The potential for interaction is greater in coastal areas than pelagic areas where Navy vessel use is less concentrated. However, even in areas of concentrated vessel use, the probability of seabird/vessel or bat/vessel interaction is low because of the high mobility of seabirds and bats that would allow them to move away from an oncoming vessel. Flushing of birds is expected to be greatest when vessels, towed devices, and unmanned surface vehicles are operated at relatively high speeds (as described in Tables 3.0-17 through 3.0-23). While such flushing or other impacts of vessels on individual birds may occur, and bats may be temporarily displaced from foraging areas, none of these temporary impacts are expected to have an impact on the long-term fitness of individual birds or bats or have population-level impacts.

Disturbance or strike from vessels or in-water devices are not expected to have lasting effects on the survival, growth, recruitment, or reproduction of bird or bat populations. Similarly, vessels and in-water devices would not result in impacts to critical habitat for piping plover because there is no overlap of the stressor with designated critical habitat. No long-term or population-level impacts are expected.

Pursuant to the ESA, the use of vessels and in-water devices during testing activities as described under Alternative 1 would have no effect on piping plover critical habitat, but may affect Bermuda petrels, piping plovers, roseate terns, red knots, Indiana bats, and northern long-eared bats. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in this regard.

3.9.3.4.1.2 Impacts from Vessels and In-Water Devices Under Alternative 2

Impacts from Vessels and In-Water Devices Under Alternative 2 for Training Activities

Under Alternative 2, potential impacts to birds or bats resulting from vessels and in-water devices associated with training activities would be similar to those of Alternative 1, but would be expected to occur with slightly greater frequency. Training over a 5-year period under Alternative 2 would have approximately 2.1 percent more vessel activities (Tables 3.0-18 and 3.0-19) and 5.3 percent more in-water device activities (Tables 3.0-22 and 3.0-23). Refer to Section 3.9.3.4.1.1 (Impacts from Vessels and In-Water Devices under Alternative 1) for a discussion of potential impacts. The potential for disturbance to individual birds or bats, and the number of individuals affected, would increase proportionately, but these impacts would still be temporary and unlikely to affect the long-term fitness of individuals or have population-level impacts.

Pursuant to the ESA, the use of vessels and in-water devices during training activities as described under Alternative 2 would have no effect on piping plover critical habitat, but may affect Bermuda petrels, piping plovers, roseate terns, red knots, Indiana bats, and northern long-eared bats.

Impacts from Vessels and In-Water Devices Under Alternative 2 for Testing Activities

Under Alternative 2, potential impacts to birds or bats resulting from vessels and in-water devices associated with testing activities would be similar to those of Alternative 1, but would be expected to occur with greater frequency. Testing over a 5-year period under Alternative 2 would have approximately 7.0 percent more vessel activities (Table 3.0-18 and Table 3.0-19) and 8.5 percent more in-water device activities (Tables 3.0-22 and 3.0-23). Refer to Section 3.9.3.4.1.1 (Impacts from Vessels and In-Water Devices under Alternative 1) for a discussion of potential impacts. The potential for disturbance to individual birds or bats and the number of individuals affected would increase proportionately, but these impacts would still be temporary and unlikely to affect the long-term fitness of individuals or have population-level impacts.

Pursuant to the ESA, the use of vessels and in-water devices during testing activities as described under Alternative 2 would have no effect on piping plover critical habitat, but may affect Bermuda petrels, piping plovers, roseate terns, red knots, Indiana bats, and northern long-eared bats.

3.9.3.4.1.3 Impacts from Vessels and In-Water Devices Under the No Action Alternative

Impacts from Vessels and In-Water Devices Under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various physical disturbance and strike stressors (e.g. vessels and in-water devices) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.9.3.4.2 Impacts from Aircraft and Aerial Targets

Information on aircraft and aerial target use is provided in Section 3.0.3.3.4.4 (Aircraft) and Appendix A (Navy Activity Descriptions). Bird or bat strikes could occur during training and testing activities that use aircraft, particularly in nearshore areas, where birds and bats are more concentrated in the Study Area. Training and testing activities where aircraft are used typically occur further offshore, within the range complexes.

Bird-aircraft strikes are a serious concern for the Navy because these incidents can result in injury to aircrews as well as damage equipment and injure or kill birds (Bies et al., 2006). The Naval Aviation Safety Program Instruction, Chief of Naval Operations Instruction 3750.6R, identifies measures to evaluate and reduce or eliminate bird/animal aircraft strike hazards to aircraft, aircrews, and birds and requires the reporting of all strikes when damage or injuries occur as a result of a bird/aircraft strike. From 2006 to 2015, the Navy Bird/Animal Aircraft Strike Hazard program recorded 10,496 bird strikes Navy-wide with the majority occurring during the fall period from September to November. During the 10-year period, bird strikes were greatest in the year 2015 with 1,283 strikes, and lowest in the year 2008 with 755 (Naval Safety Center, 2017). However, the numbers of bird deaths that occur annually from all Navy activities are insignificant from a bird population standpoint. Since 2006, naval aviators reported 10,496 bird strikes at a cost of approximately $105 million (Naval Safety Center, 2017). About 90 percent of wildlife/aircraft damaging collisions involving commercial and military aircraft involve large birds or large flocks of smaller birds (Federal Aviation Administration, 2003). ESA-listed seabird strikes reported in the aircraft strike database include a roseate tern in the East China Sea in 2007; western snowy plovers at Naval Air Station Point Mugu in 2009 and 2014; a least tern in Kingsville, Texas in 2014; and a California least Tern at Naval Air Station North Island in 2008.

Bird or bat strike potential is greatest in foraging or resting areas, in migration corridors at night, and at low altitudes during the periods around dawn and dusk. For example, birds can be attracted to airports because they often provide foraging and nesting resources. Approximately 97 percent of the reported civilian aircraft-wildlife damaging strikes from 1990 to 1999 involved common, large-bodied birds or large flocks of small birds. Almost 70 percent of these events involved gulls, waterfowl, and raptors (Federal Aviation Administration, 2003). Nicholls and Racey (2009) and Ahlén et al. (2009) found that bat foraging activity is substantially reduced in the vicinity of radar; as such, bats may avoid airports because of the radar used to track aircraft.

As described in Section 2.1.1.3 (Standard Operating Procedures), the Navy implements standard operating procedures for aircraft safety. Pilots of Navy aircraft make every attempt to avoid large flocks of birds to reduce the safety risk involved with a potential bird strike. Since 2011, the Navy has required that all Navy flying units report all bird strikes through the Web-Enabled Safety System Aviation Mishap and Hazard Reporting System. The standard operating procedures for aircraft safety will benefit birds and bats through a reduction in the potential for aircraft strike.

While wildlife strikes can occur anywhere aircraft are operated, Navy data indicate that they occur most often within the airfield environment – i.e. over land or close to shore (Naval Air Station Jacksonville, 2012). Dolbeer (2006) reports that about 90 percent of aircraft-wildlife strikes occur on or near airports, when aircraft are below altitudes of 3,500 ft. For military rotary-wing aircraft, wildlife strikes happened most frequently when the aircraft were traveling en route (flying [moving forward] at an altitude greater than 1,000 ft. above ground level) or were engaged in terrain flight (flying at an altitude less than 1,000 ft. above ground level), as opposed to (1) hovering (off the ground at less than 1,000 ft. above ground level, and stationary), (2) on approach (in the early stages of the landing process at greater than 100 ft. above ground level and moving forward), (3) landing (the final stages of landing at less than 100 ft. above ground level), (4) taxiing (moving along the ground, or at less than 10 ft. above ground level, in transition from one part of the airport to another), (5) taking off (leaving the ground and ascending upward at less than 100 ft. above ground level), or (6) climbing out (for rotary-wing aircraft in the later stages of taking off at greater than 100 ft. above ground level) (Washburn et al., 2014). The potential for bird strikes to occur in offshore areas is relatively low because Navy activities are widely dispersed and above 3,000 ft. (for fixed-wing aircraft) where bird densities are low. The potential for bat strikes to occur in offshore areas is substantially lower than that for birds because bat densities are substantially lower than bird densities in these areas.

For the majority of fixed-wing activities, flight altitudes would be above 3,000 ft., with the exception of sorties associated with air-to-surface bombing exercises and sonobuoy drops. Typical flight altitudes during air-to-surface bombing exercises are from 500 to 5,000 ft. above ground level. Most fixed-wing aircraft flight hours (greater than 90 percent) occur at distances greater than 12 NM offshore.

Helicopter flights would occur closer to the shoreline where sheltering, roosting, and foraging birds and bats occur. Helicopters can hover and fly low, and would be used to tow electromagnetic devices as well as for other military activities at sea. This combination would make helicopter bird or bat strikes more likely than for fixed-wing aircraft. Additional details on typical altitudes and characteristics of aircraft used in the Study Area are provided in Chapter 2 (Description of Proposed Action and Alternatives) and Section 3.0.3.3.4.4 (Aircraft).

Approximately 95 percent of bird flight during migration occurs below 10,000 ft., with the majority below 3,000 ft. (U.S. Geological Survey, 2006). Aircraft encounters with birds or bats are more likely to occur during aircraft takeoffs and landings than when the aircraft is engaged in low-level flight. In a study that examined 38,961 bird and aircraft collisions, Dolbeer (2006) found that the majority (74 percent) of collisions occurred below 500 ft. However, collisions have been recorded at elevations as high as 12,139 ft. (Dove & Goodroe, 2008).

Bird and bat populations may consist of hundreds or thousands of individuals, ranging across a large geographical area. In this context, the loss of a small number of birds or bats due to physical strikes does not constitute a population-level effect. Bird or bat exposure to a strike potential would be relatively brief as an aircraft transits the area. Strike potential is further decreased by Navy aircrafts' active avoidance of large flocks of birds.

In addition to manned aircraft, aerial targets such as unmanned drones could also incur a bird or bat strike, however, evidence from returned drones indicate the probability is low.In a bird strike study for the U.S. Air Force, vultures were the most hazardous group to aircraft, followed by geese, pelicans, and buteo hawks, based on the number of bird strikes reported (Zakrajsek & Bissonette, 2005). These species groups occur within the Study Area but are generally found in nearshore areas (Mowbray et al., 2002; Shields et al., 2002). The potential for bird or bat strikes to occur in offshore areas is relatively low because activities are widely dispersed and occur at relatively high altitudes (above 3,000 ft. for fixed-wing aircraft) where seabird or bat occurrences are generally low.

3.9.3.4.2.1 Impacts from Aircraft and Aerial Targets Under Alternative 1

Impacts from Aircraft and Aerial Targets Under Alternative 1 for Training Activities

Aircraft use in the Study Area is described in Section 3.0.3.3.4.4 (Aircraft). Approximately 131,000 training activities involving aircraft would occur annually in the Study Area under Alternative 1, with activities concentrated in the Virginia Capes, Navy Cherry Point, Jacksonville, and Key West Range Complexes (Tables 3.0-37 and 3.0-38). Aerial targets used in the Study Area are described in Appendix A (Navy Activity Descriptions) (A.1.3, Targets) and include expendable rocket-powered missiles and recoverable radio-controlled drones, as well as air-launched decoys (A.2.3.6, Missile Exercise Air-to-Air). Under Alternative 1 for Training Activities, approximately 207 air targets (decoy) and 55 air targets (drone) would be expended annually (Table 3.0-29).

Some individual bird or bat strikes and associated bird or bat mortalities or injuries could occur as a result of aircraft and aerial target use in the Study Area under the Alternative 1; however, population-level impacts to birds would not likely result. ESA-listed species could be impacted by aircraft disturbance or strikes while in flight in areas where low-altitude operations are taking place. However, no ESA-listed bird or bat strikes have been reported during training activities.

Although piping plover critical habitat occurs throughout the coastal habitats of the Southeast U.S. Continental Shelf and Gulf of Mexico Large Marine Ecosystems, it does not overlap with fixed-wing aircraft training which would take place further than 1 NM from shore. While aircraft overflights could occur near piping plover critical habitat, the altitudes of their flight paths would be high enough to not pose a direct strike risk to piping plovers while sheltering, roosting, or feeding. Potential impacts from aircraft and aerial targets would have no effect on critical habitat for the piping plover.

Helicopters can hover and fly low as well as out over the open ocean. The combination of helicopters hovering and flying low over the open ocean could result in possible strikes to ESA-listed piping plover, roseate tern, red knot, Bermuda petrel, or northern long-eared bat. As described in Section 5.3 (Procedural Mitigation to be Implemented), the Navy will implement mitigation to avoid potential impacts from rotary-wing aircraft overflight noise on piping plovers and other nesting birds during explosive ordnance disposal activities, including maneuvering to maintain a specified distance from the beach within the Virginia Capes Range Complex (except when transiting from Norfolk Naval Station to waters offshore) and from Fisherman Island National Wildlife Refuge off the coast of Cape Charles, Virginia (when transiting from Norfolk Naval Station to waters offshore). The mitigation for aircraft overflight noise will consequently help avoid potential physical disturbance and strike impacts on birds that occur in these locations.

Bird or bat exposure to strike potential would be relatively brief as an aircraft quickly passes. Disturbance by aircraft and aerial targets would be temporary and inconsequential to the long-term fitness of individuals. Bird or bat strikes may occur to a relatively small number of individuals, but no population-level impacts would occur, especially when considering the Navy's standard operating procedures for aircraft safety (see Section 2.1.1.3, Standard Operating Procedures) and mitigation (see Chapter 5, Mitigation).

Pursuant to the ESA, the use of aircraft and aerial targets during training activities as described under Alternative 1 would have no effect on piping plover critical habitat, but may affect Bermuda petrels, piping plovers, roseate terns, red knots, Indiana bats, and northern long-eared bats. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in this regard.

Impacts from Aircraft and Aerial Targets Under Alternative 1 for Testing Activities

Aircraft use in the Study Area is described in Section 3.0.3.3.4.4 (Aircraft). Approximately 7,700 testing activities involving aircraft would occur annually in the Study Area under Alternative 1, with activities especially concentrated in the Virginia Capes Range Complex (Tables 3.0-37 and 3.0-38). Under Alternative 1 for testing activities, 7 air targets (decoy) and 316 air targets (drone) would be expended annually (Table 3.0-31). Impacts from testing activities would be similar to those of training activities, but would occur in proportion to the number of activities, i.e., less frequent interactions with aircraft, more frequent interactions with targets as compared to training. Disturbance by aircraft and aerial targets would be temporary and inconsequential to long-term fitness of individuals. Bird or bat strikes may occur to a relatively small number of individuals, but no population-level impacts would occur, especially when considering the Navy's standard operating procedures for aircraft safety (see Section 2.1.1.3, Standard Operating Procedures).

Pursuant to the ESA, the use of aircraft and aerial targets during testing activities as described under Alternative 1 would have no effect on piping plover critical habitat, but may affect Bermuda petrels, piping plovers, roseate terns, red knots, Indiana bats, and northern long-eared bats. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in this regard.

3.9.3.4.2.2 Impacts from Aircraft and Aerial Targets Under Alternative 2

Impacts from Aircraft and Aerial Targets Under Alternative 2 for Training Activities

The use of aircraft and aerial targets under Alternative 2 for training would be virtually identical to what would occur under Alternative 1 (Tables 3.0-37, 3.0-38, and 3.0-29); therefore, the same impact conclusions apply.

Pursuant to the ESA, the use of aircraft and aerial targets during training activities as described under Alternative 2 would have no effect on piping plover critical habitat, but may affect Bermuda petrels, piping plovers, roseate terns, red knots, Indiana bats, and northern long-eared bats.

Impacts from Aircraft and Aerial Targets Under Alternative 2 for Testing Activities

Compared to Alternative 1, the use of aircraft under Alternative 2 for testing would be slightly greater (5.3 percent difference over a 5-year period) (Tables 3.0-37 and 3.0-38) but would be the same for targets (Table 3.0-31). Therefore, impacts would be slightly greater under Alternative 2, but would still be inconsequential due to the relatively small number of individuals affected and the lack of population-level effects.

Pursuant to the ESA, the use of aircraft and aerial targets during testing activities as described under Alternative 2 would have no effect on piping plover critical habitat, but may affect Bermuda petrels, piping plovers, roseate terns, red knots, Indiana bats, and northern long-eared bats.

3.9.3.4.2.3 Impacts from Aircraft and Aerial Targets Under the No Action Alternative

Impacts from Aircraft and Aerial Targets Under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various physical disturbance and strike stressors (e.g., aircraft and aerial targets) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.9.3.4.3 Impacts from Military Expended Materials

This section analyzes the strike potential to birds and bats from the following categories of military expended materials: (1) all sizes of non-explosive practice munitions, (2) fragments from high-explosive munitions, and (3) expended materials other than munitions, such as sonobuoys, and expendable targets. See Appendix F (Military Expended Materials and Direct Strike Impact Analyses) for more information on the locations, types and quantities of military expended materials proposed to be used.

Exposure of birds or bats to military expended materials during Navy training and testing activities could result in physical injury or behavioral disturbances to birds or bats in air, at the surface, or underwater during foraging dives. Although a quantitative analysis is not possible due to the absence of bird or bat density information in the Study Area, an assessment of the likelihood of exposure to military expended materials was conducted based on general bird and bat distributions in the Study Area.

The widely dispersed area in which bombs and missiles would be expended in the Study Area annually (see Chapter 2, Description of Proposed Action and Alternatives), coupled with the often patchy distribution of seabirds (Fauchald et al., 2002; Haney, 1986a; Schneider & Duffy, 1985) and the infrequent use of the Study Area by foraging bats (Ahlén et al., 2009; Bureau of Ocean Energy Management, 2013; Johnson et al., 2011; U.S. Department of Energy, 2016), suggest that the probability of these types of ordnance striking a seabird or bat would be low. The number of small-caliber projectiles that would be expended annually during various activities (e.g., gunnery exercises) is much higher than the number of large-caliber projectiles and other large munitions. However, the total number of rounds expended is not a good indicator of strike probability during gunnery exercises because multiple rounds of large-caliber projectiles and other large munitions are generally fired at individual targets during a single event.

Human activity such as vessel or boat movement, aircraft overflights, and target placement, could cause birds or bats to flee a target area before the onset of firing, thus avoiding harm. If birds or bats were in the target area, they would likely flee the area prior to the release of military expended materials or just after the initial rounds strike the target area. Additionally, the force of military expended material fragments dissipates quickly once the pieces hit the water, so direct strikes on birds foraging below the surface would not be likely. Also, munitions would not be used in shallow/nearshore areas. The potential likelihood of individual birds or bats being struck by munitions is very low; thus, impacts on bird or bat populations would not be expected.

3.9.3.4.3.1 Impacts from Military Expended Materials Under Alternative 1

Impacts from Military Expended Materials Under Alternative 1 for Training Activities

Table B-1 in Appendix B (Actvivity Stressor Matrices) provides a breakdown of the different activities that generate these military expended materials for training. Tables 3.0-24, 3.0-25, 3.0-27, 3.0-29, 3.0-30, and 3.0-32 in Section 3.0.3.3.4.2 (Military Expended Materials) provide a breakdown of the types of materials expended and the loctations of where they are expended under both action alternatives for training. Training activities would occur throughout the Study Area. Appendix F (Military Expended Materials and Direct Strike Impact Analyses) provides details on the types, numbers and footprints of expended materials by location.

The potential impact of military expended materials on birds or bats in the Study Area is dependent on the ability of birds or bats to detect and avoid foreign objects through their sensory systems and the relatively fast flying speeds and maneuverability of most bird and bat species. The potential for impact is related to the probability of a bird or bat and a projectile meeting in the same space at the same time. The amount of materials expended over the vast area over which training and testing activities occur, combined with the ability of birds and bats to flee disturbance and the infrequent use of the Study Area by foraging bats (Ahlén et al., 2009; Bureau of Ocean Energy Management, 2013; Johnson et al., 2011; U.S. Department of Energy, 2016), would make direct strikes unlikely. Individual birds or bats may be impacted, but strikes would have no impact on species or populations.

Direct strikes from firing weapons (projectiles) or air-launched devices (e.g., sonobuoys, torpedoes) are a potential stressor to seabirds and bats. Seabirds in flight, resting on the water's surface, or foraging just below the water surface, as well as bats in flight, would be vulnerable to a direct strike. Strikes have the potential to injure or kill seabirds or bats in the Study Area. However, there would not be long-term population-level impacts. The footprint calculations in Appendix F (Military Expended Materials and Direct Strike Impact Analyses, Tables F-2 through F-7) indicate relatively small areas of impact and, consequently, a low probability of strikes to birds by the types of materials that pose the greatest risk to birds (e.g., projectiles, torpedoes, surface targets) on an annual or cumulative 5-year basis. Since bats occur in the Study Area much less frequently than birds, it is expected that the likelihood of a bat strike is proportionally less than that for a bird strike. Furthermore, the vast area over which training activities occur combined with the ability of seabirds and bats to flee disturbance, would make direct strikes unlikely. Individual seabirds or bats may be affected, but strikes would have no impact on species or populations.

If ESA-listed species were in the immediate area where military expended materials are present, they could be impacted by military expended material strikes. It is highly unlikely that a bird or bat would be struck by military expended materials because most birds and bats in the vicinity of the approaching aircraft or vessel, from which the military expended materials are released, would likely be dispersed by the sound of its approach before it could come close enough for an impact from a strike or a disturbance to take place. Therefore, activities that release military expended materials would not likely cause any potential strike risk to birds or bats in the Study Area.

Although designated piping plover critical habitat occurs throughout the coastal habitats of the Southeast U.S. Continental Shelf and Gulf of Mexico Large Marine Ecosystems, none of these areas overlap with the use of military expended materials in the Study Area. Behavioral changes are not expected to have lasting effects on the survival, growth, recruitment, or reproduction of bird populations. Therefore, none of the military expended materials will affect piping plover critical habitat. No long-term or population-level impacts are expected.

Pursuant to the ESA, the use of military expended materials during training activities as described under Alternative 1 would have no effect on piping plover critical habitat, Indiana bats, or northern long-eared bats; but may affect Bermuda petrels, piping plovers, roseate terns, and red knots. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in this regard.

Impacts from Military Expended Materials Under Alternative 1 for Testing Activities

Table B-2 in Appendix B (Actvivity Stressor Matrices) provides a breakdown of the different activities that generate these military expended materials for testing. Tables 3.0-26, 3.0-28, 3.0-31, and 3.0-33 in Section 3.0.3.3.4.2 (Military Expended Materials) provide a breakdown of the types of materials expended and the loctations of where they are expended under both action alternatives for testing. Testing activities would occur throughout the Study Area. Appendix F (Military Expended Materials and Direct Strike Impact Analyses) provides details on the types, numbers and footprints of expended materials by location.

The potential impact of military expended materials on birds or bats in the Study Area is dependent on the ability of birds or bats to detect and avoid foreign objects through their sensory systems and the relatively fast flying speeds and maneuverability of most bird and bat species. The potential for impact is related to the probability of a bird or bat and a projectile meeting in the same space at the same time. The amount of materials expended over the vast area over which training and testing activities occur, combined with the ability of birds and bats to flee disturbance and the infrequent use of the Study Area by foraging bats (Ahlén et al., 2009; Bureau of Ocean Energy Management, 2013; Johnson et al., 2011; U.S. Department of Energy, 2016), would make direct strikes unlikely. Individual birds or bats may be impacted, but strikes would have no impact on species or populations.

Direct strikes from firing weapons (projectiles) or air-launched devices (e.g., sonobuoys, torpedoes) are a potential stressor to seabirds and bats. Seabirds in flight, resting on the water's surface, or foraging just below the water surface, as well as bats in flight, would be vulnerable to a direct strike. Strikes have the potential to injure or kill seabirds or bats in the Study Area. However, there would not be long-term population-level impacts. The footprint calculations in Appendix F (Military Expended Materials and Direct Strike Impact Analyses, Tables F-14 through F-17) indicate relatively small areas of impact and, consequently, a low probability of strikes to birds by the types of materials that pose the greatest risk to birds (e.g., projectiles, torpedoes, surface targets) on an annual or cumulative 5-year basis. Since bats occur in the Study Area much less frequently than birds, it is expected that the likelihood of a bat strike is proportionally less than that for a bird strike. Furthermore, the vast area over which testing activities occur combined with the ability of seabirds and bats to flee disturbance, would make direct strikes unlikely. Individual seabirds or bats may be affected, but strikes would have no impact on species or populations.

If ESA-listed species were in the immediate area where military expended materials are present, they could be impacted by military expended material strikes. It is highly unlikely that a bird or bat would be struck by military expended materials because most birds and bats in the vicinity of the approaching aircraft or vessel, from which the military expended materials are released, would likely be dispersed by the sound of its approach before it could come close enough for an impact from a strike or a disturbance to take place. Therefore, activities that release military expended materials would not likely cause any potential strike risk to birds or bats in the Study Area.

Pursuant to the ESA, the use military expended materials during testing activities as described under Alternative 1 would have no effect on piping plover critical habitat, piping plovers, red knots, Indiana bats, or northern long-eared bats; but may affect Bermuda petrels and roseate terns. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in this regard.

3.9.3.4.3.2 Impacts from Military Expended Materials Under Alternative 2

Impacts from Military Expended Materials Under Alternative 2 for Training Activities

The differences in expended materials between Alternatives 1 and 2 for training activities are relatively small and inconsequential with respect to the types of materials that pose the greatest risk to birds (Appendix F, Military Expended Materials and Direct Strike Impact Analyses, Tables F-2 through F-7). Since bats occur in the Study Area much less frequently than birds, it is expected that the likelihood of a bat strike is proportionally less than that for a bird strike. As a result, impacts of military expended materials from training activities under Alternative 2 would be essentially the same as those of Alternative 1.

Pursuant to the ESA, the use of military expended materials during training activities as described under Alternative 2 would have no effect on piping plover critical habitat, Indiana bats, or northern long-eared bats; but may affect Bermuda petrels, piping plovers, roseate terns, and red knots.

Impacts from Military Expended Materials Under Alternative 2 for Testing Activities

The differences in expended materials between Alternatives 1 and 2 for testing activities are relatively small and inconsequential with respect to the types of materials that pose the greatest risk to birds (Appendix F, Military Expended Materials and Direct Strike Impact Analyses, Tables F-14 through F-17). Since bats occur in the Study Area much less frequently than birds, it is expected that the likelihood of a bat strike is proportionally less than that for a bird strike. As a result, impacts of military expended materials from testing activities under Alternative 2 would be essentially the same as those of Alternative 1.

Pursuant to the ESA, the use of military expended materials during testing activities as described under Alternative 2 would have no effect on piping plover critical habitat, piping plovers, red knots, Indiana bats, or northern long-eared bats; but may affect Bermuda petrels and roseate terns.

3.9.3.4.3.3 Impacts from Military Expended Materials Under the No Action Alternative

Impacts from Military Expended Materials Under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various physical disturbance and strike stressors (e.g., military expended materials) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.9.3.4.4 Impacts from Seafloor Devices

As discussed in Section 3.0.3.3.4.3 (Seafloor Devices), seafloor devices that are used during training and testing activities are deployed onto the seafloor in shallow water and later recovered. Because these devices are stationary or very slow moving, they do not pose a risk of physical disturbance or strike to birds, including ESA-listed species. Since bats do not occur in the water column, there is no potential for seafloor devices and bats to interact. Because of this, seafloor devices would have no impacts to birds or bats and will not be discussed further. Pursuant to the ESA, the use of seafloor devices during training and testing activities as described under Alternatives 1 and 2 would have no effect on piping plover critical habitat, Bermuda petrels, piping plovers, red knots, roseate terns, Indiana bats, or northern long-eared bats. The Navy has consulted on Alterntive 1 with the USFWS as required by section 7(a)(2) of the ESA in this regard.

3.9.3.4.5 Impacts from Pile Driving

There would be no pile driving or vibratory pile extraction associated with testing activities. Therefore, pile driving related to testing is not analyzed in this subsection. Section 3.9.3.1.4 (Impacts from Pile Driving) describes the impacts from noise to birds and bats that would occur from the installation and removal of piles in the vicinity of training events involving the construction of an Elevated Causeway System, a temporary pier that allows the offloading of ships in areas without a permanent port. Human activity such as vessel or boat movement, and equipment setting and movement, is expected to cause birds and bats to flee the activity area before the onset of pile driving. If birds or bats were in the activity area, they would likely flee the area prior to, or just after, the initial strike of the pile at the beginning of the ramp-up procedure. Pile driving during training is, therefore, not considered physical disturbance or strike stressor for birds or bats. Pursuant to the ESA, pile driving during training activities as described under Alternatives 1 and 2 would have no effect on piping plover critical habitat, Bermuda petrels, piping plovers, red knots, roseate terns, Indiana bats, or northern long-eared bats. The Navy has consulted on Alterntive 1 with the USFWS as required by section 7(a)(2) of the ESA in this regard.

3.9.3.5 Entanglement Stressors

This section analyzes the potential entanglement impacts of the various types of expended materials used by the Navy during training and testing activities within the Study Area. This analysis includes the potential impacts of three types of military expended materials, including: (1) wires and cables, (2) decelerators/parachutes, and (3) biodegradable polymers. Aspects of entanglement stressors that are applicable to marine organisms in general are presented in Section 3.0.3.3.5 (Entanglement Stressors). The annual numbers and locations of expended wires, cables, parachutes, and activities using biodegradable polymers are provided in Tables 3.0-32 through 3.0-34.

Along the continental U.S. and near Hawaii, at least 44 species of seabirds are known to become entangled in plastic or marine debris. From 2001–2005, entanglement rates ranged from 0.2% to 1.2% for all seabirds observed by beach monitoring programs in California, Oregon, and Washington. Common murres and western gulls were the most common species found entangled. While the vast majority of entanglements involved fishing gear (e.g., monofilament line and hooks), approximately 8.3% of the entanglements were from non-fishery-related items (e.g., plastics and other synthetic materials that they may gather for making nests). Cormorants in Maine have been observed making nests from such plastic marine debris, including net fragments and fishing line. It is thought that the biggest threat of entanglement from using debris as nesting material is to the chicks, but no such entanglements have been observed (National Oceanic and Atmospheric Administration, 2016).

Given the limited amount of time that wires and cables would remain suspended in air and the ability of birds and bats to detect and avoid parachutes in-air, the likelihood that a bird or bat would become entangled in-air is considered remote and discountable. As such, this analysis is focused on the potential for entanglement at the water surface, in the water column, or on the seafloor.

The cables, wires, decelerators/parachutes, and biodegradable polymer are relatively conspicuous in contrast to fishing lines, do not form long loops of line that are hard to break, do not tend to snag animals that swim through them, and do not persist for a long time in the water column. The Navy-expended materials sink gradually (0.24 m/second in the case of guidance wires) to the bottom. These materials would be readily avoided by visually oriented seabirds that could be foraging or resting in the water. Unlike fishing gear, the Navy's equipment does not capture fish and therefore decreases the attractiveness to foraging seabirds. Additional information is provided in the sections below.

Since bats considered in this analysis do not occur in the water column, rarely occur at the water surface in the Study Area, and would not be attracted to cables, wires, or decelerators/parachutes, few, if any, impacts to bats are anticipated from these entanglement stressors. As discussed in Section 3.9.2.1.3 (Dive Behavior), the Mexican bulldog bat (or fishing bat) primarily eats fish caught with its relatively large feet and long, sharp claws near the water's surface and would not be expected to become entangled with any entanglement stressor. Furthermore, this species occurs outside of the Study Area in Mexico, Puerto Rico, and the U.S. Virgin Islands (Jones et al., 1973; Placer, 1998) and is expected to venture into the Study Area while foraging only infrequently. Therefore, bats are not evaluated further for entanglement stressors.

3.9.3.5.1 Impacts from Wires and Cables

Table B-1 in Appendix B (Actvivity Stressor Matrices) provides a breakdown of the different activities that have wires and cables for training. Table 3.0-39 in Section 3.0.3.3.5.1 (Wires and Cables) provides a breakdown of the types of wires and cables used and the quantities and loctations of where they are used under both action alternatives for training. These items include fiber optic cables, guidance wires, and sonobuoy components.

Fiber optic cables are flexible cables that can range in size up to 300 m in length. The length of guidance wires would generally be equal to the distance the torpedo or missile travels to impact the target, which may increase entanglement risk to birds with long wires (over 1,000 m) expended into the environment. Sonobuoys consist of a surface antenna and float unit and a subsurface hydrophone assembly unit. The two units are attached through a thin-gauge, dual-conductor, hard draw copper strand cable, which is then wrapped by a hollow rubber tubing or bungee in a spiral configuration. The length of cable that extends out is no more than 1500 ft. and is dependent on the water depth and type of sonobuoy. The hydrophone components maybe covered by thin plastic netting depending on type of sonobuoy. Each sonobuoy has a saltwater activated polyurethane float that inflates when the sonobuoy is submerged and keeps the sonobuoy components floating vertically in the water column below it. Sonobuoys remain suspended in the water column for no more than 30 hours, after which they sink to the seafloor. While longer cables present a higher likelihood of bird interactions, and therefore present an increased risk of entanglement of a bird, these cables should be readily avoidable by birds that could be foraging or resting in the water.

The entanglement risk from these components would only occur when a bird and these components were in close proximity at the water surface, in the water column, or on the seafloor. As stated above, however, these materials would be readily avoided by visually oriented seabirds that could be foraging or resting in the water and do not pose the same entanglement risks as fishing gear. Some sonobuoy components, once they sink to the bottom, may be transported by bottom currents or active tidal influence, and present an enduring entanglement risk. In the benthic environment, however, subsequent colonization by encrusting organisms, burying by sediment, and chemical breakdown of the various materials would further reduce the potential for reintroduction as an entanglement risk.

3.9.3.5.1.1 Impacts from Wires and Cables under Alternative 1

Impacts from Wires and Cables under Alternative 1 for Training Activities

As discussed in Section 3.0.3.3.5.1 (Wires and Cables), under Alternative 1 training activities, fiber optic cables, guidance wires, and sonobuoy components that would pose an entanglement risk to birds would be expended primarily in the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, and Gulf of Mexico Range Complexes. However, given that these stressors are widely dispersed over vast areas and do not persist or accumulate at the surface or in the water column where seabirds forage, encounters with seabirds would be infrequent. This is coupled with a remote likelihood that a bird encountering the expended material would become entangled, as described above. As a result, the potential for entanglement from wires and cables to lead to injury or mortality is negligible. Therefore, no long-term or population-level impacts to birds would occur.

Pursuant to the ESA, the use of wires and cables during training activities as described under Alternative 1 would have no effect on Bermuda petrels, piping plovers, roseate terns, red knots, Indiana bats, or northern long-eared bats, and would have no effect on piping plover critical habitat. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in this regard.

Impacts from Wires and Cables under Alternative 1 for Testing Activities

As discussed in Section 3.0.3.3.5.1 (Wires and Cables), under Alternative 1 testing activities, fiber optic cables, guidance wires, and sonobuoy components that would pose an entanglement risk to birds would be expended primarily in the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes, along with testing ranges (Naval Undersea Warfare Center Newport, South Florida Ocean Measurement Facility, and Naval Surface Warfare Center Panama). However, given that these stressors are widely dispersed over vast areas and do not persist or accumulate at the surface or in the water column where seabirds forage, encounters with seabirds would be infrequent. This is coupled with a remote likelihood that a bird encountering the expended material would become entangled, as described above. As a result, the potential for entanglement from wires and cables to lead to injury or mortality is negligible. Therefore, no long-term or population-level impacts to birds would occur.

Pursuant to the ESA, the use of wires and cables during testing activities as described under Alternative 1 would have no effect on Bermuda petrels, piping plovers, roseate terns, red knots, Indiana bats, or northern long-eared bats, and would have no effect on piping plover critical habitat. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in this regard.

3.9.3.5.1.2 Impacts from Wires and Cables under Alternative 2

Impacts from Wires and Cables under Alternative 2 for Training Activities

As discussed in Section 3.0.3.3.5.1 (Wires and Cables), under Alternative 2 training activities, fiber optic cables, guidance wires, and sonobuoy components would be expended in the same areas as Alternative 1, with increases in the number of expended items that would pose an entanglement risk. Under Alternative 2, increases in sonobuoy component releases would occur in Virginia Capes, Navy Cherry Point, Jacksonville, and Gulf of Mexico Range Complexes. Fiber optic cable releases would increase under Alternative 2 in Virginia Capes, Jacksonville, and Gulf of Mexico Range Complexes, while there would be no change in the number or locations of guidance wire releases compared to Alternative 1. Given the foregoing analysis, however, the impacts would be essentially the same as for Alternative 1. Therefore, no long-term or population-level impacts to birds would occur.

Pursuant to the ESA, the use of wires and cables during training activities as described under Alternative 2 would have no effect on Bermuda petrels, piping plovers, roseate terns, red knots, Indiana bats, or northern long-eared bats, and would have no effect on piping plover critical habitat.

Impacts from Wires and Cables under Alternative 2 for Testing Activities

As discussed in Section 3.0.3.3.5.1 (Wires and Cables), under Alternative 2 testing activities, fiber optic cables, guidance wires, and sonobuoy components would be expended in the same areas as Alternative 1, with increases to the number of expended items that would pose an entanglement risk. Under Alternative 2, increases in sonobuoy component releases would occur in Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes. Fiber optic cable releases would increase under Alternative 2 in Virginia Capes Range Complex and Naval Surface Warfare Center Panama, while there would be no change in the number or locations of guidance wire releases compared to Alternative 1. Given the foregoing analysis, however, the impacts would be essentially the same as for Alternative 1. Therefore, no long-term or population-level impacts to birds would occur.

Pursuant to the ESA, the use of wires and cables during testing activities as described under Alternative 1 would have no effect on Bermuda petrels, piping plovers, roseate terns, red knots, Indiana bats, or northern long-eared bats, and would have no effect on piping plover critical habitat.

3.9.3.5.1.3 Impacts from Wires and Cables under the No Action Alternative

Impacts from Wires and Cables under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various entanglement stressors (e.g., wires and cables) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.9.3.5.2 Impacts from Decelerators/Parachutes

Section 3.0.3.3.5.2 (Decelerators/Parachutes) describes the use and platforms where decelerators/parachutes would be released into the marine environment and therefore present an entanglement risk to birds. Aircraft-launched sonobuoys, lightweight torpedoes (such as the MK 46 and MK 54), illumination flares, and targets use nylon decelerators/parachutes ranging in size from 1.5 to 82 feet in diameter. The majority are relatively small cruciform shape decelerators/parachutes associated with sonobuoys (18 to 48 inches in diameter). Once a sonobuoy hits the water surface, its decelerator/parachute is designed to produce drag at the surface for 5–15 seconds, allowing for deployment of the sonobuoy, then the decelerator/parachute separates and sinks. The decelerator/parachute assembly contains metallic components and could be at the surface for a short period before sinking to the seafloor. Sonobuoy decelerators/parachutes are designed to sink within 15 minutes, but the rate of sinking depends upon sea conditions and the shape of the decelerator/parachute, and the duration of the descent would depend on the water depth. Decelerators/parachutes or decelerator/parachute lines may be a risk for birds to become entangled, particularly while at the surface. As stated above, however, these materials would be readily avoided by visually oriented seabirds that could be foraging or resting in the water and do not pose the same entanglement risks as fishing gear.

If the decelerator/parachute and its lines sink to the seafloor in an area where the bottom is calm, it would remain there undisturbed. Over time, it may become covered by sediment in most areas or colonized by attaching and encrusting organisms, which would further stabilize the material and reduce the potential for reintroduction as an entanglement risk. If bottom currents are present, the canopy may billow and pose an entanglement threat to birds that feed in benthic habitats. Bottom-feeding birds tend to forage in nearshore areas rather than offshore, where these decelerators/parachutes are used; therefore, birds are not likely to encounter decelerators/parachutes once they reach the seafloor. The potential for a bird to encounter an expended decelerator/parachute at the surface or in the water column is extremely low, it is even less probable at the seafloor given the general improbability of a bird being near the deployed decelerator/parachute as well as the general behavior of birds. Depending on how quickly the decelerator/parachute may degrade, the risk may increase with time if the decelerator/parachute remains intact. Factors that may influence degradation times include exposure to ultraviolet radiation and the extent of physical damage of the decelerator/parachute on the water's surface, as well as water temperature and sinking depth.

3.9.3.5.2.1 Impacts from Decelerators/Parachutes under Alternative 1

Impacts from Decelerators/Parachutes under Alternative 1 for Training Activities

As detailed in Table 3.0-32, under Alternative 1 training activities, decelerators/parachutes that would pose an entanglement risk to birds would be expended primarily in the Northeast, Virginia Capes, Navy Cherry Point, and Jacksonville Range Complexes. However, given that these stressors are widely dispersed over vast areas and do not persist or accumulate at the surface or in the water column where seabirds forage, encounters with seabirds would be infrequent. This is coupled with a remote likelihood that a bird encountering the expended material would become entangled, as described above. As a result, the potential for entanglement from decelerators/parachutes to lead to injury or mortality is negligible. Therefore, no long-term or population-level impacts to birds would occur.

Pursuant to the ESA, the use of decelerators/parachutes during training activities as described under Alternative 1 would have no effect on Bermuda petrels, piping plovers, roseate terns, red knots, Indiana bats, or northern long-eared bats, and would have no effect on piping plover critical habitat. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in this regard.

Impacts from Decelerators/Parachutes under Alternative 1 for Testing Activities

As detailed in Table 3.0-34, under Alternative 1 testing activities, decelerators/parachutes that would pose an entanglement risk would be used throughout the range complexes and testing ranges of the Study Area. However, given that these stressors are widely dispersed over vast areas and do not persist or accumulate at the surface or in the water column where seabirds forage, encounters with seabirds would be infrequent. This is coupled with a remote likelihood that a bird encountering the expended material would become entangled, as described above. As a result, the potential for entanglement from decelerators/parachutes to lead to injury or mortality is negligible. Therefore, no long-term or population-level impacts to birds would occur.

Pursuant to the ESA, the use of decelerators/parachutes during testing activities as described under Alternative 1 would have no effect on Bermuda petrels, piping plovers, roseate terns, red knots, Indiana bats, or northern long-eared bats, and would have no effect on piping plover critical habitat. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in this regard.

3.9.3.5.2.2 Impacts from Decelerators/Parachutes under Alternative 2

Impacts from Decelerators/Parachutes under Alternative 2 for Training Activities

Under Alternative 2, the number of decelerators/parachutes that would be expended during training activities would be about 2.8 percent larger than under Alternative 1. This difference reflects the addition of training activities using decelerators/parachutes in the Gulf of Mexico Range Complex (Table 3.0-32). This would proportionally increase the possibility of entanglement relative to Alternative 1, but, the likelihood of injury or mortality is still considered negligible, and the impact conclusion for decelerators/parachutes under Alternative 2 training activities is the same as for Alternative 1.

Pursuant to the ESA, the use of decelerators/parachutes during training activities as described under Alternative 2 would have no effect on Bermuda petrels, piping plovers, roseate terns, red knots, Indiana bats, or northern long-eared bats, and would have no effect on piping plover critical habitat.

Impacts from Decelerators/Parachutes under Alternative 2 for Testing Activities

Under Alternative 2, the number of decelerators/parachutes that would be expended during testing activities would be about 8.6 percent larger than under Alternative 1, with the same general distribution of activities throughout the Study Area (Table 3.0-34). This would proportionally increase the possibility of entanglement relative to Alternative 1, but, the likelihood of injury or mortality is still considered negligible, and the impact conclusion for decelerators/parachutes under Alternative 2 testing activities is the same as for Alternative 1.

Pursuant to the ESA, the use of decelerators/parachutes during testing activities as described under Alternative 2 would have no effect on Bermuda petrels, piping plovers, roseate terns, red knots, Indiana bats, or northern long-eared bats, and would have no effect on piping plover critical habitat.

3.9.3.5.2.3 Impacts from Decelerators/Parachutes under the No Action Alternative

Impacts from Decelerators/Parachutes under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various entanglement stressors (e.g., decelerators/parachutes) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.9.3.5.3 Impacts from Biodegradable Polymers

The possibility of entanglement in the biodegradable polymer is considered remote and discountable given the fact that the material is only deployed on a small-scale in test locations (Table 3.0-42), is short-lived in the water, and that diving birds routinely navigate through floating vegetation without becoming entangled (unlike boat propellers which the polymer is designed to entangle). The biodegradable polymer is, therefore, not considered an entanglement stressor for birds.

3.9.3.6 Ingestion Stressors

As described in Section 3.0.3.3.6 (Ingestion Stressors), the types of expended materials that are potentially a source of ingestion stressors include non-explosive practice munitions (small and medium caliber), fragments from high-explosive munitions, fragments from targets, chaff, plastic end caps from chaff cartridges, the plastic compression pads, end caps from pistons and flares, small decelerators/parachutes, and biodegradable polymers (discussed in Section 3.0.3.3.5.3, Biodegradable

Polymer). Other types of expended materials are too large to be mistaken for food items and consumed by birds. Since bats considered in this analysis do not occur in the water column and rarely feed at the water surface in the Study Area, few, if any, impacts to bats are anticipated from ingestion stressors. As such, impacts to bats from ingestion stressors will not be discussed further.

3.9.3.6.1 Impacts from Military Expended Materials - Munitions

Two types of munitions are potentially a source of ingestion stressors: non-explosive practice munitions (small and medium caliber) and fragments from high-explosive munitions. Both types of munitions sink rapidly through the water column and settle to the bottom. Munitions are not used in nearshore-shallow areas and, because of their density, are likely to bury in the bottom and are unlikely to be transported from offshore to nearshore. It is thus highly unlikely that munitions would accumulate where benthic nearshore or intertidal foraging would occur. Rapidly sinking munitions and fragments are unlikely to be accessible or attractive as potential food items to diving birds that feed on fish and invertebrates in the water column. Accordingly, there are no potential impacts to birds feeding in the water column or on the bottom from this category of ingestion stressors and it will not be discussed further.

3.9.3.6.2 Impacts from Military Expended Materials - Other Than Munitions

The analysis in this section includes the potential ingestion of military expended materials other than munitions, all of which are expended away from nearshore habitats and close to the water surface. Tables 3.0-24 through 3.0-28; 3.0-32 through 3.0-34; and 3.0-43 and 3.0-44 describe the annual quantities and locations where these materials would be generated by training and testing activities under Alternatives 1 and 2. Appendix A (Navy Activity Descriptions) provides more specific information on the activities that may result in ingestion stressors, and the typical locations where these activities occur.

While it has been widely documented that a wide range of marine organisms (including zooplankton, baleen whales, and seabirds) will ingest plastic, the mechanism that causes these organisms to do so was discovered only recently (Savoca, 2016; Savoca et al., 2016). Procellariiformes, or tube-nosed seabirds (e.g., albatrosses, shearwaters and petrels) utilize a highly developed sense of smell to find food that is patchily distributed in offshore and open ocean environments. Specifically, these birds are attracted to dimethyl sulfide, which is produced when the cell walls of algae are damaged (e.g., when marine herbivores such as krill eat it), thereby alerting the seabirds that food (e.g., krill) are nearby. Through a literature review, Savoca et al. (2016) demonstrated that seabirds that utilize dimethyl sulfide as a foraging cue consumed plastic nearly six times more frequently than species that were not attracted to dimethyl sulfide. Savoca et al. (2016) also performed field studies that confirmed that algae growing on three of the most common types of plastic debris (polypropylene and low- and high-density polyethylene) can produce dimethyl sulfide within three weeks at concentrations at least four orders of magnitude above the behavioral detection threshold for Antarctic prions (*Pachyptila desolata*), thereby creating an “olfactory trap.”

Birds could potentially ingest expended materials other than munitions used by the Navy during training and testing activities within the Study Area. The Navy expends the following types of materials that could become ingestion stressors for birds during training and testing in the Study Area: missile components, target fragments, chaff and flare endcaps/pistons, and decelerators/parachutes. Biodegradable polymers generated during countermeasures testing are also considered. Ingestion of expended materials by birds could occur in all large marine ecosystems and open ocean areas and would occur either at the surface or just below the surface portion of the water column, depending on the size and buoyancy of the expended object and the feeding behavior of the birds. Floating material of ingestible size could be eaten by birds that feed at or near the water surface, while materials that sink pose a potential risk to diving birds that feed just below the water's surface (Titmus & Hyrenbach, 2011). Some items, such as decelerators/parachutes or sonobuoys are too large to be ingested and will not be discussed further. Also, decelerators/parachutes sink rapidly to the seafloor.

Physiological impacts to birds from ingestion include blocked digestive tracts and subsequent food passage, blockage of digestive enzymes, lowered steroid hormone levels, delayed ovulation (egg maturation), reproductive failure, nutrient dilution (nonnutritive debris displaces nutritious food in the gut), exposure to indirect effects from harmful chemicals found in and on the plastic material, and altered appetite satiation (the sensation of feeling full), which can lead to starvation (Azzarello & Van Vleet, 1987; Provencher et al., 2014). While ingestion of marine debris has been linked to bird mortalities, sublethal impacts are more common (Moser & Lee, 1992).

Many species of seabirds are known to ingest floating plastic debris and other foreign matter while feeding on the surface of the ocean (Auman et al., 1997; Provencher et al., 2014; Yamashita et al., 2011). A recent review of the literature documented the ingestion of marine debris by 122 species of seabirds (Gall & Thompson, 2015). Evidence indicates that physical and toxicological impacts from plastic ingestion by seabirds are widespread among species and pervasive in terms of the number of individuals affected, and that impacts are increasing (Wilcox et al., 2016). For example, 21 of 38 seabird species (55 percent) collected off the coast of North Carolina from 1975 to 1989 contained plastic particles (Moser & Lee, 1992). The mean particle sizes of ingested plastic were positively correlated with the birds' size though the mean mass of plastic found in the stomachs and gizzards of 21 species was below 3 grams. Some seabirds have used plastic and other marine debris for nest building which may lead to ingestion of that debris (Votier et al., 2011). Indirect ingestion of plastic also occurs from consuming prey such as fish that ingest plastic.

Plastic is often mistaken for prey, and the incidence of plastic ingestion appears to be related to a bird's feeding mode and diet (Henry et al., 2011; Provencher et al., 2014). Seabirds that feed by pursuit diving, surface-seizing, and dipping tend to ingest plastic, while those that feed by plunging or piracy typically do not ingest plastic (Azzarello & Van Vleet, 1987; Provencher et al., 2014). Birds of the order Procellariiformes, which include petrels, shearwaters, and albatrosses, tend to accumulate more plastic than other species (Azzarello & Van Vleet, 1987; Moser & Lee, 1992; Pierce et al., 2004; Provencher et al., 2014). Some birds, including gulls and terns, commonly regurgitate indigestible parts of their food items such as shell and fish bones. However, the structure of the digestive systems of most Procellariiformes makes it difficult to regurgitate solid material such as plastic (Azzarello & Van Vleet, 1987; Moser & Lee, 1992; Pierce et al., 2004).

As summarized by Pierce et al. (2004), Auman et al. (1997), and Azzarello and Van Vleet (1987), documented consequences of plastic ingestion by seabirds include blockage of the intestines and ulceration of the stomach, reduction in the functional volume of the gizzard leading to a reduction of digestive capability, and distention of the gizzard leading to a reduction in hunger. Dehydration has also been documented in seabirds that have ingested plastic (Sievert & Sileo, 1993). Studies have also found negative correlations between body weight and plastic load, as well as between body fat (a measure of energy reserves), and the number of pieces of plastic in a seabird's stomach (Auman et al., 1997; Sievert & Sileo, 1993). Other possible concerns that have been identified include toxic plastic additives and toxic contaminants that could be adsorbed to the plastic from ambient seawater. Pierce et al. (2004)

described two cases where plastic ingestion caused seabird mortality from starvation. The examination of a deceased adult northern gannet revealed that a 1.5 in. diameter plastic bottle cap lodged in its gizzard blocked the passage of food into the small intestine, which resulted in its death from starvation. Northern gannets are substantially larger, and dive deeper than the ESA-listed birds in the Study Area. Also, since gannets typically utilize flotsam in nest building (Votier et al., 2011), they may be more susceptible to ingesting marine debris than other species as it gathers that material. Dissection of an adult greater shearwater's gizzard revealed that a 1.5 in. by 0.5 in. fragment of plastic blocked the passage of food in the digestive system, which also resulted in death from starvation.

Species such as storm-petrels, albatrosses, shearwaters, fulmars, and noddies that forage by picking prey from the surface may have a greater potential to ingest any floating plastic debris. Ingestion of plastic military expended materials by any species from the 10 taxonomic groups found within the Study Area (Table 3.9-1) has the potential to impact individual birds. Ocean currents concentrate plastic debris, making birds that feed along frontal zones more susceptible (Azzarello & Van Vleet, 1987). While some seabird mortality could occur, these factors indicate that a small number of birds would be affected and that population-level effects would not be expected.

Items of concern are those of ingestible size that remain floating at the surface, including lighter items such as plastic end caps from chaff and flares, pistons, and chaff, that may be caught in currents and gyres or snared in floating *Sargassum* before sinking.

Target-Related Materials. As described in Section 3.0.3.3.6.3 (Military Expended Materials Other Than Munitions), at-sea targets are usually remotely-operated airborne, surface, or subsurface traveling units, most of which are designed to be recovered for reuse. However, if they are used during activities that utilize high-explosives then they may result in fragments. Expendable targets that may result in fragments would include air-launched decoys, surface targets (e.g., marine markers, paraflares, cardboard boxes, and 10 ft. diameter red balloons), and mine shapes. Most target fragments would sink quickly to the seafloor. Floating material, such as Styrofoam, may be lost from target boats and remain at the surface for some time. Only targets that may result in smaller fragments that do not immediately sink are included in the analyses of ingestion potential.

There are additional types of targets discussed previously, but only surface targets, subsurface targets, air targets, sinking exercise ship hulks, and mine shapes would be expected to result in fragments when high-explosive munitions are used.

Chaff. As described in Section 3.0.3.3.6.3 (Military Expended Materials Other Than Munitions), large areas of air space and open water within the Study Area would be exposed to chaff at very low concentrations. This same section also provides a general discussion of chaff as an ingestion stressor and concludes that chaff poses little risk to organisms, except at concentrations substantially higher than those that could reasonably occur from military training. Additional information is provided below.

It is unlikely that chaff would be selectively ingested (U.S. Air Force, 1997). Ingestion of chaff fibers is not expected to cause substantial damage to a bird's digestive tract based on the fibers' small size (ranging in lengths of 0.25–3 in. with a diameter of about 40 micrometers) and flexible nature, as well as the small quantity that could reasonably be ingested. In addition, concentrations of chaff fibers that could reasonably be ingested are not expected to be toxic to birds. Scheuhammer (1987) reviewed the metabolism and toxicology of aluminum in birds and mammals. Intestinal adsorption of orally ingested aluminum salts was very poor, and the small amount adsorbed was almost completely removed from the body by excretion. Dietary aluminum normally has minor impacts on healthy birds and mammals, and often high concentrations (greater than 1,000 milligrams per kilogram) are needed to induce effects such as impaired bone development, reduced growth, and anemia (U.S. Department of the Navy, 1999). A bird weighing 2.2 pounds (lb.) would need to ingest more than 83,000 chaff fibers per day to receive a daily aluminum dose equal to 1,000 milligram per kilogram; this analysis was based on chaff consisting of 40 percent aluminum by weight and a 5-ounce chaff canister containing 5 million fibers. As an example, an adult herring gull weighs about 1.8–2.7 lb. (Cornell Lab of Ornithology, 2009). It is highly unlikely that a bird would ingest a toxic dose of chaff based on the anticipated environmental concentration of chaff (i.e., 1.8 fibers per square foot for an unrealistic, worst-case scenario of 360 chaff cartridges simultaneously released at a single drop point).

Flares. A general discussion of flares as an ingestion stressor is presented in Section 3.0.3.3.6.3 (Military Expended Materials Other Than Munitions). Ingestion of flare compression pads or pistons 1.3 in. in diameter and 0.13 in. thick (U.S. Air Force, 1997) by birds may result in gastrointestinal obstruction or reproductive complications. Based on the information presented above, if a seabird were to ingest a compression pads or pistons, the response would vary based on the species and individual bird. The responses could range from none, to sublethal (reduced energy reserves), to lethal (digestive tract blockage leading to starvation). Ingestion of compression pads or pistons by species that regularly regurgitate indigestible items would likely have no adverse impacts. However, compression pads or pistons are similar in size to those plastic pieces described above that caused digestive tract blockages and eventual starvation. Therefore, ingestion of compression pads or pistons could be lethal to some individual seabirds. Species with small gizzards and anatomical constrictions that make it difficult to regurgitate solid material would likely be most susceptible to blockage (such as Procellariiformes). Based on available information, it is not possible to accurately estimate actual ingestion rates or responses of individual birds.

Biodegradable Polymer. The biodegradable polymer used in countermeasure testing could theoretically be ingested by birds; however, the likelihood is low because the material would persist only until the polymer degrades. Some of the polymer constituents would dissolve within two hours of immersion and it is anticipated that the material will breakdown into small pieces within a few days to weeksof deployment (discussed in Section 3.0.3.3.5.3, Biodegradable Polymer). Therefore, the biodegradable polymer is not considered an ingestion stressor for birds and will not be discussed further.

3.9.3.6.2.1 Impacts from Military Expended Materials - Other Than Munitions Under Alternative 1

Impacts from Military Expended Materials- Other Than Munitions Under Alternative 1 for Training Activities

As indicated in Section 3.0.3.3.6.3 (Military Expended Materials Other Than Munitions), the use of chaff, flares, and targets would occur and could generate expended materials constituting ingestion stressors throughout the Study Area. Although chaff fibers and pieces of biodegradable polymer are too small for birds to confuse with prey, there is some potential for chaff and biodegradable polymer to be incidentally ingested along with other prey items. If ingested, neither chaff nor biodegradable polymer are expected to impact birds, due to the low concentration that would be ingested and the small size of the fibers.

The plastic materials associated with flare compression pads or pistons sink in saltwater (U.S. Department of the Navy, 1999), which reduces the likelihood of ingestion by seabirds. However, some of the material could remain at or near the surface if it were to fall directly on a dense *Sargassum* mat. Actual environmental concentrations would vary based on actual release points and dispersion by wind and water currents. The number of compression pads and pistons that would remain at the surface in *Sargassum* mats, and would potentially be available to seabirds, is expected to be an extremely small percentage of the total.

Although the overall concentration of military expended materials would be low, and Navy standard practice is to collect and remove as much Styrofoam as possible when retrieving a degraded target, military expended materials would not be evenly distributed. Similarly, seabirds are not evenly distributed in the Study Area (Fauchald et al., 2002; Haney, 1986a, 1986b; Schneider & Duffy, 1985). As noted previously, there is some potential for expended materials that float (e.g., some types of target fragments or chaff end caps or flare compression pads and pistons) to become concentrated along frontal zones, along with food resources that tend to attract foraging seabirds, resulting in the incidental ingestion of such materials, most likely as very small fragments. Military expended materials would constitute a minute portion of the floating debris that seabirds would be exposed to and may accidentally consume in such situations, but could nevertheless contribute to harmful effects of manmade debris on some seabirds. The overall likelihood that individual birds would be negatively impacted by ingestion of military expended materials in the Study Area under Alternative 1 for training is considered low, but not discountable. Population-level effects would be very unlikely given the relatively small quantities and limited persistence of military expended materials in habitats where birds are most likely to forage. This conclusion applies to ESA-listed bird species as well.

If foraging in an area where military expended materials are present on the sea surface, roseate terns and Bermuda petrels could ingest military expended materials. The odds of this are low because of the very low density of birds and large areas over which they forage, combined with the low density of Navy activities and expended materials across the vast Study Area. Piping plovers and red knots may encounter expended materials on beaches (e.g., along the James River and tributaries where up to 20,400 flares would be expended per year [Table 3.0-33]). A bird's consumption of a piece of Navy-expended material may or may not be harmful, but if added to the burden of marine debris from other sources (Wilcox et al., 2016), harmful effects would be more likely. Effects to individuals are thus possible, but it is unlikely that populations of these ESA-listed species would be affected. The same considerations apply to the rare but unlisted black-capped petrel. No long-term or population-level impacts are expected.

Pursuant to the ESA, the potential for ingestion of military expended materials other than munitions during training activities as described under Alternative 1 would have no effect on Indiana bats, northern long-eared bats, or piping plover critical habitat; but may affect Bermuda petrels, piping plovers, red knots, and roseate terns. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in this regard.

Impacts from Military Expended Materials - Other Than Munitions Under Alternative 1 for Testing Activities

Testing activities under Alternative 1 would generate the same types of ingestible materials generated by training activities. As shown in Tables 3.0-26, 3.0-28, 3.0-31, 3.0-34, and 3.0-42, the quantity of materials used during testing activities would generally be substantially less than those used during training activities (except for mine shapes, which would be used substantially more frequently during testing activities). Testing activities would also occur in other areas not used for training activities (e.g., Naval Undersea Warfare Center Newport Testing Range, Naval Surface Warfare Center Carderock Division's South Florida Ocean Measurement Facility, and Naval Surface Warfare Center Panama City

Testing Range). Therefore, testing activities would have similar, but generally reduced, impacts to those of training activities under Alternative 1.

Pursuant to the ESA, the potential for ingestion of military expended materials other than munitions during testing activities as described under Alternative 1 would have no effect on Indiana bats, northern long-eared bats, piping plovers, red knots, or piping plover critical habitat; but may affect Bermuda petrels and roseate terns. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in this regard.

3.9.3.6.2.2 Impacts from Military Expended Materials - Other Than Munitions Under Alternative 2

Impacts from Military Expended Materials - Other Than Munitions Under Alternative 2 for Training Activities

Training activities under Alternative 2 would generate the same types of ingestible materials generated by training activities under Alternative 1. While the quantities and locations of some expended materials would change slightly, the vast majority would be the same under Alternative 2 as under Alternative 1 (Tables 3.0-24, 3.0-25, 3.0-29, 3.0-30, and 3.0-32). Therefore, the implementation of Alternative 2 would have similar impacts to those of training activities under Alternative 1.

Pursuant to the ESA, the potential for ingestion of military expended materials other than munitions during training activities as described under Alternative 2 would have no effect on Indiana bats, northern long-eared bats, or piping plover critical habitat; but may affect Bermuda petrels, piping plovers, red knots, and roseate terns.

Impacts from Military Expended Materials - Other Than Munitions Under Alternative 2 for Testing Activities

Testing activities under Alternative 2 would generate the same types of ingestible materials generated by testing activities under Alternative 1. While the quantities and locations of some expended materials would change slightly, the vast majority would be the same under Alternative 2 as under Alternative 1 (Tables 3.0-26, 3.0-28, 3.0-31, 3.0-34, and 3.0-42). Therefore, the implementation of Alternative 2 would have similar impacts to those of testing activities under Alternative 1.

Pursuant to the ESA, the potential for ingestion of military expended materials other than munitions during testing activities as described under Alternative 2 would have no effect on Indiana bats, northern long-eared bats, piping plovers, red knots, or piping plover critical habitat; but may affect Bermuda petrels and roseate terns.

3.9.3.6.2.3 Impacts from Military Expended Materials - Other Than Munitions Under the No Action Alternative

Impacts from Military Expended Materials - Other Than Munitions Under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various physical disturbance and strike stressors (e.g., military expended materials other than munitions) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.9.3.7 Secondary Stressors

This section analyzes potential impacts on birds exposed to stressors indirectly through impacts to habitat and prey availability (e.g., sediment, water and air quality). Since these stressors also affect primary elements of bird habitat, firm distinctions between indirect impacts and habitat impacts are difficult to maintain. It is important to note that the terms “indirect” and “secondary” do not imply reduced severity of environmental consequences, but instead describe how the impact may occur in an organism or its ecosystem.

Stressors from Navy training and testing activities could pose secondary or indirect impacts on birds via impacts to habitat, sediment, or water quality. Disturbing sediment or impacting water quality could also impact the food-chain, which in turn could largely impact vital seabird habitat and prey availability. Components of these stressors that could pose indirect impacts are detailed in Tables 2.6-1 to 2.6-5, and analyses of their potential impacts are discussed in Section 3.2 (Sediments and Water Quality), Section 3.4 (Invertebrates), Section 3.5 (Habitats), and Section 3.6 (Fishes).

Since bats considered in this analysis do not occur in the water column and rarely feed at the water surface in the Study Area, few, if any, impacts to bats are anticipated from secondary stressors. As such, impacts to bats from secondary stressors will not be discussed further.

3.9.3.7.1 Impacts on Habitat

The potential of water, air quality, and abiotic habitat stressors associated with training and testing activities to indirectly affect birds, as a secondary stressor, was analyzed. The assessment of potential water, air quality, and abiotic habitat stressors is discussed in previous sections in this DEIS/OEIS (Section 3.1, Air Quality; Section 3.2, Sediments and Water Quality; and Section 3.5, Habitats). These analyses addresses specific activities in local environments that may affect bird habitats. At-sea activities that may impact water and air include general emissions, and at-sea activities that may affect habitats include explosives and physical disturbance and strike.

As noted in Sections 3.1 (Air Quality), Section 3.2 (Sediments and Water Quality), and Section 3.5 (Habitats), implementation of the No Action Alternative, Alternative 1, or Alternative 2 would minimally impact sediments, water, air quality, or habitats, and therefore would not indirectly impact seabirds as secondary stressors. Furthermore, any physical impacts on seabird habitats would be temporary and localized because training and testing activities would occur infrequently. These activities would not be expected to indirectly impact birds or bird habitats.

Although designated piping plover critical habitat occurs throughout the coastal habitats of the Southeast U.S. Continental Shelf and Gulf of Mexico Large Marine Ecosystems, none of these areas overlap activities that could potentially impact sediments, water, or air quality. While piping plovers do forage in the intertidal portions of the Study Area, these areas do not overlap with any locations where military activities occur that have any potential to impact sediments, water, or air quality. Therefore, secondary stressors will not affect piping plover critical habitat.

Indirect impacts on sediments, water, or air quality under Alternative 1 or Alternative 2 would have no effect on ESA-listed bird species due to: (1) the temporary nature of impacts on sediments, water, or air quality, (2) the distribution of temporary sediments, water, or air quality impacts, (3) the wide distribution of birds in the Study Area, and (4) the dispersed spatial and temporal nature of the training and testing activities that may have temporary sediments, water, or air quality impacts. No long-term or population-level impacts are expected.

Pursuant to the ESA, secondary impacts on habitat during training or testing activities as described under Alternative 1 would have no effect on piping plover critical habitat, Bermuda pretrels, piping plovers, red knots, and roseate terns. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in this regard.

3.9.3.7.2 Impacts on Prey Availability

As noted in Section 3.4 (Invertebrates) and Section 3.6 (Fishes), implementation of the No Action Alternative, Alternative 1, or Alternative 2 would not adversely impact populations of invertebrate or fish prey resources (e.g., crustaceans, bivalves, worms, sand lance, herring, etc.) of birds and therefore would not indirectly impact birds as secondary stressors. Any impacts on seabird prey resources would be temporary and localized. Furthermore, as discussed above, these activities are expected to have minimal impacts to bird habitats. Additional detail is provided below.

As discussed in Section 3.4.3.7 (Secondary Stressors), impacts on invertebrate prey availability resulting from explosives, explosives byproducts, unexploded munitions, metals, and chemicals would likely be negligible overall and population-level impacts on marine invertebrates are not expected. Because individuals of many invertebrate taxa prey on other invertebrates, mortality resulting from explosions or exposure to metals or chemical materials would reduce the number of invertebrate prey items available. A few species prey upon fish, and explosions and exposure to metals and chemical materials could result in a minor reduction in the number of fish available. However, the effect is expected to be small and discountable. Any vertebrate or invertebrate animal killed or significantly impaired by Navy activities could potentially represent an increase in food availability for scavenging invertebrates. None of the effects described above would likely be detectable at the population or subpopulation level.

As noted in Section 3.6.3.7.2, (Fishes, Impacts on Prey Availability), prey species might exhibit a strong startle reaction to detonations that might include swimming to the surface or scattering away from the source. This startle and flight response is the most common secondary defense among animals (Hanlon & Messenger, 1996). The sound from underwater explosions might induce startle reactions and temporary dispersal of schooling fishes if they are within close proximity to an explosion (Popper et al., 2014; Wright, 1982), which in turn could make them more visible to predators (Kastelein et al., 2008). The abundances of fish and invertebrate prey species near the detonation point could be diminished for a short period of time before being repopulated by animals from adjacent waters. Alternatively, any prey species that would be directly injured or killed by the blast could draw in scavengers from the surrounding waters that would feed on those organisms, who in turn could be susceptible to becoming directly injured or killed by subsequent explosions. Any of these scenarios would be temporary, only occurring during activities involving explosives, and no lasting impact on prey availability or the food web would be expected. Indirect impacts of underwater detonations and high-explosive munitions use under the Proposed Action would not result in a decrease in fish populations in the Study Area.

Based on Sections 3.4 (Invertebrates) and 3.6 (Fishes), project-related stressors would not impact populations of invertebrates and fishes that support birds in the Study Area. Therefore, no secondary impacts to birds associated with prey availability are expected. Furthermore, the Navy will implement mitigation (e.g., not conducting gunnery activities within a specified distance of shallow-water coral reefs) to avoid potential impacts from explosives and physical disturbance and strike stressors on seafloor resources in mitigation areas throughout the Study Area (see Section 5.4.1, Mitigation Areas for Seafloor Resources). This mitigation will consequently help avoid potential impacts on bird prey that inhabits shallow-water coral reefs, live hard bottom, artificial reefs, and shipwrecks.

Pursuant to the ESA, secondary impacts on prey availability during training or testing activities as described under Alternative 1 would have no effect on piping plover critical habitat, Bermuda pretrels, piping plovers, red knots and roseate terns. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in this regard.

3.9.4 Summary of Potential Impacts on Birds and Bats

3.9.4.1 Combined Impacts of All Stressors Under Alternative 1

As described in Section 3.0.3.5 (Resource-Specific Impacts Analysis for Multiple Stressors), this section evaluates the potential for combined impacts of all stressors from the Proposed Action. The analysis and conclusions for the potential impacts from each of the individual stressors are discussed in the sections above and, for ESA-listed species, summarized in Section 3.9.5 (Endangered Species Act Determinations). Stressors associated with Navy training and testing activities do not typically occur in isolation but rather occur in some combination. For example, mine neutralization activities include elements of acoustic, physical disturbance and strike, entanglement, ingestion, and secondary stressors that are all coincident in space and time. An analysis of the combined impacts of all stressors considers the potential consequences of aggregate exposure to all stressors and the repetitive or additive consequences of exposure over multiple years. The individual stressor analyses provided previously indicate that the vast majority of exposures to stressors are non-lethal. Hence the analysis of combined effects focuses on consequences potentially impacting the organism's fitness (e.g., physiology, behavior, reproductive potential).

Most of the birds in the Study Area are relatively long-lived and wide-ranging seabirds, making it likely that individuals would be exposed to multiple activities and stressors over the course of their lifespans. Multiple stressors can affect individual birds in two ways: 1) from exposure to multiple sources of stress during a single event or activity; and 2) from exposure to a combination of stressors over the course of the bird's life. Both general scenarios are more likely to occur where training and testing activities are concentrated. The key difference between the two scenarios is the amount of time between exposures to stressors. Time is an important factor because subsequent disturbances or injuries often increase the time needed for the organism to recover to baseline behavior or physiology, extending the time that the organism's fitness is impacted. On the other hand, bats are not relatively long-lived and occur in the Study Area only infrequently while foraging. As such, individual bats are unlikely to be exposed to a combination of stressors over the course of its lifetime.

Birds and bats are susceptible to multiple stressors (see Section 3.9.2.1.5, General Threats), and the susceptibility of many species could be enhanced by additive or synergistic effects of multiple stressors. As discussed in the analyses above, birds and bats are not particularly susceptible to energy, entanglement, or ingestion stressors resulting from Navy activities; therefore, the opportunity for Navy stressors to result in additive or synergistic consequences is most likely limited to acoustic/explosive, and physical strike and disturbance stressors. The potential for impacts associated with combined acoustic/explosive and physical strike and disturbance stressors is lessened by the fact that most activities are conducted offshore in areas where birds, and especially bats, occur at relatively low concentrations.

Despite uncertainty in the nature of consequences resulting from combined impacts, the location of potential combined impacts can be predicted with more certainty because combinations are much more likely in locations where training and testing activities are concentrated. However, analyses of the nature of potential consequences of combined impacts of all stressors on birds and bats remain largely qualitative and speculative. For example, an individual bird or bat that becomes injured or disoriented from an acoustic or explosive exposure may be less able to avoid subsequent exposure to physical disturbance and strike. Where multiple stressors coincide with high abundances of birds (bats do not occur in the Study Area in high abundance), the possibilities of negative consequences are increased, but not enough is known about the potential additive or synergistic effects to predict them with any confidence. Stressors vary in intensity, with injuries or mortality occurring rarely, and most exposures not having persistent or accumulating effects to individuals or populations. In general, combined impacts will depend upon the coincidence of multiple stressors affecting the same individuals at the same place and time. Such occurrences are relatively infrequent because the activities and stressors are widely dispersed, affecting very small portions of the Study Area and relatively small numbers of individuals at any given time.

It is also likely that Navy stressors will combine with non-Navy stressors, as qualitatively discussed in Chapter 4 (Cumulative Impacts).

3.9.4.2 Combined Impacts of All Stressors Under Alternative 2

Combined impacts of all stressors under Alternative 2 would be largely the same as, but incrementally greater than, those of Alternative 1. Given the slightly larger number of activities overall and proportionately greater exposure of birds and bats to most types of stressors, the potential for additive or synergistic effects is slightly greater under Alternative 2 than Alternative 1. However, as for Alternative 1, the nature of combined impacts is difficult to predict or quantify. Activities and the resultant stressors are widely dispersed, affecting very small portions of the Study Area and relatively small numbers of individuals at any given time.

3.9.4.3 Combined Impacts of All Stressors Under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various stressors would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.9.5 Endangered Species Act Determinations

Pursuant to the ESA, the Navy identified Alternative 1 as the preferred alternative under the proposed action. As identified in section 3.9.3 (Environmental Consequences), under Alternative 1, Navy training and testing activities may affect ESA-listed bird or bat species and will have no effect on designated critical habitat because the proposed action does not have any elements with the potential to modify such habitat. In all cases for which a “may affect” determination was reached, the Navy determined that the corresponding activities are not likely to adversely affect the species. The Navy has consulted with the USFWS as required by section 7(a)(2) of the ESA in that regard. The Navy’s ESA determinations for the effects of specific stressors on birds and bats under Alternative 1 are summarized in Table 3.9 6 and Table 3.9 7, respectively. USFWS concurred with all Navy determinations.

3.9.6 Migratory Bird Treaty Act Determinations

The Navy has determined that the Proposed Action may result in the “take” of migratory birds. The term “take” as defined by the USFWS for Migratory Bird Treaty Act purposes means to “pursue, hunt, shoot, wound, kill, trap, capture, or collect” (50 CFR part 10.12). The Proposed Action, however is a military readiness activity; therefore, “take” is in compliance with the Migratory Bird Treaty Act. Under the Migratory Bird Treaty Act regulations applicable to military readiness activities (50 CFR Part 21), the

USFWS has promulgated a rule that authorizes the incidental take of migratory birds provided they do not result in a significant adverse effect on a population of a migratory seabird species. These proposed training and testing activities would not result in a significant adverse impact on any population of a migratory bird species.

Table 3.9-6: Bird Effect Determinations for Training and Testing Activities Under the Proposed Action

		Effect Determinations by Stressor																			
		Acoustic						***Explo-sives***	***Energy***			***Physical Disturbance and Strike***					***Entanglement***			***Ingestion***	
Species	***Designation Unit***	***Sonar and Other Transducers***	***Air Guns***	***Pile Driving***	***Vessel Noise***	***Aircraft Noise***	***Weapons Noise***	***Explosives***	***In-water Electromagnetic Devices***	***In-air Electromagnetic Devices***	***High-energy Lasers***	***Vessels***	***In-water Devices***	***Aircraft and Aerial Targets***	***Military Expended Materials***	***Seafloor Devices***	***Wires and Cables***	***Decelerators/Parachutes***	***Biodegradable Polymer***	***Military Expended Materials - Munitions***	***Military Expended Materials - Other Than Munitions***
Training Activities																					
Bermuda petrel	Throughout range	NLAA	N/A	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NE	NE	N/A	NE	NLAA
Piping plover	Throughout range	NE	N/A	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NLAA	NE	NLAA	NLAA	NLAA	NLAA	NE	NE	NE	N/A	NE	NLAA
	Critical habitat	NE	N/A	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	N/A	NE	NE
Red knot	Throughout range	NE	N/A	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NLAA	NE	NLAA	NLAA	NLAA	NLAA	NE	NE	NE	N/A	NE	NLAA
Roseate tern	Northeast Region	NE	N/A	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NE	NE	N/A	NE	NLAA
	Southeast Region	NE	N/A	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NE	NE	N/A	NE	NLAA
Testing Activities																					
Bermuda petrel	Throughout range	NLAA	NLAA	N/A	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NE	NE	NE	NE	NLAA
Piping plover	Throughout range	NE	NE	N/A	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NLAA	NLAA	NLAA	NE	NE	NE	NE	NE	NE	NE
	Critical habitat	NE	NE	N/A	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Red knot	Throughout range	NE	NE	N/A	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NLAA	NLAA	NLAA	NE	NE	NE	NE	NE	NE	NE
Roseate tern	Northeast Region	NE	NE	N/A	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NE	NE	NE	NE	NLAA
	Southeast Region	NE	NE	N/A	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NE	NE	NE	NE	NLAA

Note: NE = no effect; NLAA = may effect, not likely to adversely affect; LAA = may effect, likely to adversely affect; N/A = not applicable, activity related to the stressor does not occur during specified training or testing events (e.g., there are no testing activities that involve the use of pile driving).

This page intentionally left blank.

Table 3.9-7: Bat Effect Determinations for Training and Testing Activities under the Proposed Action

Species	Designation Unit	*Effect Determinations by Stressor*																				
		Acoustic						*Explo-sives*	*Energy*			*Physical Disturbance & Strike*						*Entanglement*			*Ingestion*	
		Sonar and Other Transducers	*Air Guns*	*Pile Driving*	*Vessel Noise*	*Aircraft Noise*	*Weapons Noise*	*Explosives*	*In-water Electromagnetic Devices*	*In-air Electromagnetic Devices*	*High-energy Lasers*	*Vessels*	*In-water Devices*	*Aircraft and Aerial Targets*	*Military Expended Materials*	*Seafloor Devices*	*Pile Driving*	*Wires and Cables*	*Decelerators/Parachutes*	*Biodegradable Polymer*	*Military Expended Materials - Munitions*	*Military Expended Materials - Other Than Munitions*
Training Activities																						
Indiana bat	Throughout range	NE	N/A	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NE	NE	NE	NE	N/A	NE	NE
Northern long-eared bat	Throughout range	NE	N/A	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NE	NE	NE	NE	N/A	NE	NE
Testing Activities																						
Indiana bat	Throughout range	NE	NE	N/A	NLAA	NLAA	NLAA	NLAA	NE	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NE	N/A	NE	NE	NE	NE	NE
Northern long-eared bat	Throughout range	NE	NE	N/A	NLAA	NLAA	NLAA	NLAA	NE	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NE	N/A	NE	NE	NE	NE	NE

Note: NE = no effect; NLAA = may effect, not likely to adversely affect; LAA = may effect, likely to adversely affect; N/A = not applicable, activity related to the stressor does not occur during specified training or testing events (e.g., there are no testing activities that involve the use of pile driving).

This page intentionally left blank.

References

Aebischer, N. J., J. C. Coulson, and J. M. Colebrook. (1990). Parallel long-term trends across four marine trophic levels and weather. *Nature, 347*(6295), 753–755.

Ahlén, I., H. J. Baagøe, and L. Bach. (2009). Behavior of Scandinavian bats during migration and foraging at sea. *Journal of Mammology, 90*(6), 1318–1323.

Akesson, S. (2003). Avian Long-Distance Navigation: Experiments with Migratory Birds. In P. Berthold & E. Gwinner (Eds.), *Bird Migration* (pp. 471–492). Berlin, Germany: Springer.

Akesson, S., and A. Hedenstrom. (2007). How migrants get there: Migratory performance and orientation. *BioScience, 57*(2), 123–133.

Alderfer, J. (2003). Auks, murres, puffins. In M. Baughman (Ed.), *National Geographic Refererence Atlas to the Birds of North America* (pp. 176–185). Washington, DC: National Geographic Society.

Alerstam, T., M. Hake, and N. Kjellen. (2006). Temporal and spatial patterns of repeated journeys by ospreys. *Animal Behaviour, 71*, 555–566.

American Ornithologists' Union. (1998). *The AOU Check-List of North American Birds* (7th ed.). Washington, DC: American Ornithologists' Union.

American Ornithologists' Union. (2017). *Checklist of North and Middle American Birds*. Retrieved from http://checklist.aou.org/taxa.

Andersen, D. E., O. J. Rongstad, and W. R. Mytton. (1989). Response of nesting red-tailed hawks to helicopter overflights. *The Condor, 91*, 96–99.

Andersen, D. E., O. J. Rongstad, and W. R. Mytton. (1990). Home-range changes in raptor exposed to increased human activity levels in southeastern Colorado. *Wildlife Society Bulletin, 18*, 134–142.

Anderson, D. W., C. J. Henny, C. Godinez-Reyes, F. Gress, E. L. Palacios, K. Santos del Prado, and J. Bredy. (2007). *Size of the California Brown Pelican Metapopulation during a non-El Niño year*. Reston, VA: U.S. Geological Survey.

Arnett, E. B., C. D. Hein, M. R. Schirmacher, M. M. Huso, and J. M. Szewczak. (2013). Evaluating the Effectiveness of an Ultrasonic Acoustic Deterrent for Reducing Bat Fatalities at Wind Turbines. *PLoS ONE, 8*(6), e65794.

Auman, H. J., J. P. Ludwig, J. P. Giesy, and T. Colborn. (1997). Plastic ingestion by Laysan Albatross chicks on Sand Island, Midway Atoll, in 1994 and 1995. In G. Robinson & R. Gales (Eds.), *Albatross Biology and Conservation* (pp. 239–244). Chipping Norton, Australia: Surrey Beatty & Sons.

Austin, O. L., Jr., J. W. Robertson, and G. E. Woolfenden. (1970). *Mass hatchling failure in Dry Tortugas sooty terns.* Paper presented at the XVth International Ornithological Congress. The Hague, Netherlands.

Azzarello, M. Y., and E. S. Van Vleet. (1987). Marine birds and plastic pollution. *Marine Ecology - Progress Series, 37*, 295–303.

Baerwald, E. F., G. H. D'Amours, B. J. Klug, and R. M. Barclay. (2008). Barotrauma is a significant cause of bat fatalities at wind turbines. *Current Biology, 18*(16), R695–R696.

Baerwald, E. F., and R. M. Barclay. (2016). Are migratory behaviours of bats socially transmitted? *Royal Society Open Science, 3*(4), 150658.

Barchi, J. R., J. M. Knowles, and J. A. Simmons. (2013). Spatial memory and stereotype of flight paths by big brown bats in cluttered surroundings. *The Journal of Experimental Biology, 216*(6), 1053–1063.

Barrett, R. T., G. Chapdelaine, T. Anker-Nilssen, A. Mosbech, W. A. Montevecchi, J. B. Reid, and R. R. Veit. (2006). Seabird numbers and prey consumption in the north Atlantic. *ICES Journal of Marine Sciences, 63*, 1145–1158.

Barron, D. G., J. D. Brawn, L. K. Butler, L. M. Romero, and P. J. Weatherhead. (2012). Effects of military activity on breeding birds. *The Journal of Wildlife Management, 76*(5), 911–918.

Bat Conservation International. (2017). *White Nose Syndrome*. Retrieved from http://www.batcon.org/our-work/regions/contact-bci/usa-canada/white-nose-syndrome.

Bates, M. E., S. A. Stamper, and J. A. Simmons. (2008). Jamming avoidance response of big brown bats in target detection. *The Journal of Experimental Biology, 211*(1), 106–113.

Bates, M. E., J. A. Simmons, and T. V. Zorikov. (2011). Bats Use Echo Harmonic Structure to Distinguish Their Targets from Background Clutter. *Science, 333,* 627–630.

Baxter, D. J. M., J. M. Psyllakis, M. P. Gillingham, and E. L. O'Brien. (2006). Behavioural response of bats to perceived predation risk while foraging. *Ethology, 112*, 997–983.

Beason, R. (2004). *What Can Birds Hear?* Lincoln, NE: University of Nebraska.

Berthinussen, A., and J. Altringham. (2012). The effect of a major road on bat activity and diversity. *Journal of Applied Ecology, 49*(1), 82–89.

Bester, A., D. Priddel, and N. Klomp. (2011). Diet and foraging behaviour of the providence petrel *Pterodroma solandri*. *Marine Ornithology, 39*, 163–172.

Beuter, K. J., R. Weiss, and B. Frankfurt. (1986). *Properties of the auditory system in birds and the effectiveness of acoustic scaring signals.* Paper presented at the Bird Strike Committee Europe, 18th Meeting Part I, 26–30 May 1986. Copenhagen, Denmark.

Bies, L., T. B. Balzer, and W. Blystone. (2006). Pocosin Lakes National Wildlife Refuge: Can the military and migratory birds mix? *Wildlife Society Bulletin, 34*, 502–503.

BirdLife International. (2008a). *Bermuda Petrel returns to Nonsuch Island after 400 years*. Retrieved from http://birdguides.com/webzine/article.asp?a=1294.

BirdLife International. (2008b). *Bermuda Petrel is being conserved through translocation and provision of artificial nest-sites*. Retrieved from http://datazone.birdlife.org/sowb/casestudy/bermuda-petrel-is-being-conserved-through-translocation-and-provision-of-artificial-nest-sites.

BirdLife International. (2008c). *Avian diseases are spreading to impact hitherto unaffected populations*. Retrieved from http://datazone.birdlife.org/sowb/casestudy/avian-diseases-are-spreading-to-impact-hitherto-unaffected-populations.

BirdLife International. (2010). *Species factsheet: Roseate Tern (Sterna dougallii)*. *BirdLife International Data Zone.* Retrieved from http://www.birdlife.org/datazone/species/index.html?action=SpcHTMDetails.asp&sid=3266&m=0.

BirdLife International. (2012). *Spotlight on seabirds*. Retrieved from http://datazone.birdlife.org/sowb/spotseabirds.

BirdLife International. (2016). *Species factsheet: Charadrius melodus*. Retrieved from http://www.birdlife.org/datazone/speciesfactsheet.php?id=3127.

Black, B. B., M. W. Collopy, H. F. Percival, A. A. Tiller, and P. G. Bohall. (1984). *Effects of Low Level Military Training Flights on Wading Bird Colonies in Florida*. Gainesville, FL: Florida Cooperative Fish and Wildlife Research Unit School of Forest Resources and Conservation University of Florida.

Bogan, M. (2016). *Potential Effects of Global Change on Bats*. Retrieved from https://geochange.er.usgs.gov/sw/impacts/biology/bats/.

Bohn, K. M., C. F. Moss, and G. S. Wilkinson. (2006). Correlated evolution between hearing sensitivity and social calls in bats. *Biology Letters, 2*(4), 561–564.

Borberg, J. M., L. T. Ballance, R. L. Pitman, and D. G. Ainley. (2005). A test for bias attributable to seabird avoidance of ships during surveys conducted in the tropical Pacific. *Marine Ornithology, 33*, 173–179.

Bost, C. A., C. Cotte, F. Bailleul, Y. Cherel, J. B. Charrassin, C. Guinet, D. G. Ainley, and H. Weimerskirch. (2009). The importance of oceanographic fronts to marine birds and mammals of the southern oceans. *Journal of Marine Systems, 78*, 363–376.

Botton, M. L., R. E. Loveland, and T. R. Jacobsen. (1994). Site selection by migratory shorebirds in Delaware Bay, and its relationship to beach characteristics and abundance of horseshoe-crab (*Limulus polyphemus*) eggs. *Auk, 111*(3), 605–616.

Bowles, A. E., F. T. Awbrey, and J. R. Jehl. (1991). *The Effects of High-Amplitude Impulsive Noise on Hatching Success: A Reanalysis of the Sooty Tern Incident*. Wright Patterson Airforce Base, OH: Noise and Sonic Boom Impact Technology Program.

Bowles, A. E., M. Knobler, M. D. Seddon, and B. A. Kugler. (1994). *Effects of Simulated Sonic Booms on the Hatchability of White Leghorn Chicken Eggs.* Brooks Air Force Base, TX: Systems Research Laboratories.

Bowles, A. E. (1995). Chapter 8: Responses of Wildlife to Noise. In R. L. Knight & K. J. Gutzwiller (Eds.), *Wildlife and Recreationists: Coexistence Through Management and Research*. Washington, DC: Island Press.

Brooke, M. (2004). Albatrosses and Petrels Across the World (pp. 520). New York, NY: Oxford University Press.

Brown, A. L. (1990). Measuring the effect of aircraft noise on sea birds. *Environmental International, 16*, 587–592.

Brown, B. T., G. S. Mills, C. Powels, W. A. Russell, G. D. Therres, and J. J. Pottie. (1999). The influence of weapons-testing noise on bald eagle behavior. *Journal of Raptor Research, 33*(3), 227–232.

Brown, J. W., and J. Harshman. (2008). *Pelecaniformes*. Retrieved from http://tolweb.org/Pelecaniformes/57152/2008.06.27.

Buehler, D. A. (2000). *Bald Eagle (Haliaeetus leucocephalus). The Birds of North America Online.* Retrieved from http://bna.birds.cornell.edu/bna/species/506.

Bureau of Ocean Energy Management. (2013). *Revised Environmental Assessment for Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Rhode Island and Massachusetts*. Washington, DC: Office of Renewable Energy Programs.

Burger, A. E., and M. Simpson. (1986). Diving depths of Atlantic puffins and common murres. *Auk, 103*(4), 828–830.

Burger, A. E. (2001). Diving depths of shearwaters. *The Auk, 118*(3), 755–759.

Burger, J. (1981). Behavioural responses of herring gulls, *Larus argentatus,* to aircraft noise. *Environmental Pollution Series A, Ecological and Biological, 24*(3), 177–184.

Burger, J., and M. Gochfeld. (1988). Nest-site selection and temporal patterns in habitat use of roseate terns. *The Auk, 105*(3), 433–438.

Burger, J., C. Gordon, J. Lawrence, J. Newman, G. Forcey, and L. Vlietstra. (2011). Risk evaluation for federally listed (roseate tern, piping plover) or candidate (red knot) bird species in offshore waters: A first step for managing the potential impacts of wind facility development on the Atlantic Outer Continental Shelf. *Renewable Energy, 36*(1), 338–351.

Burkett, E. E., N. A. Rojek, A. E. Henry, M. J. Fluharty, L. Comrack, P. R. Kelly, A. C. Mahaney, and K. M. Fien. (2003). *Status Review of Xantus's Murrelet (Synthliboramphus) in California*. Sacramento, CA: California Department of Fish and Game, Habitat Conservation Planning Branch.

California Department of Fish and Game. (2010). *State and Federally Listed Endangered and Threatened Animals of California*. Sacramento, CA: California Natural Resources Agency, Department of Fish and Game, Biogeographic Data Branch.

Calvert, A. M., D. L. Amirault, F. Shaffer, R. Elliot, A. Hanson, J. McKnight, and P. D. Taylor. (2006). Population assessment of an endangered shorebird: The piping plover (*Charadrius melodus*) in eastern Canada. *Avian Conservation and Ecology, 1*(4).

Carter, H. R., and K. J. Kuletz. (1995). Mortality of Marbled Murrelets Due to Oil Pollution in North America. In C. J. Ralph, G. L. Hunt, Jr., M. G. Raphael, & J. F. Piatt (Eds.), *Ecology and Conservation of the Marbled Murrelet* (pp. 261–269). Washington, DC: U.S. Department of Agriculture Forest Service General Technical Report PSW-152.

Carter, H. R., S. G. Sealy, E. E. Burkett, and J. F. Piatt. (2005). Biology and conservation of Xantus's Murrelet: Discovery, taxonomy, and distribution. *Marine Ornithology, 33*, 81–87.

Chiu, C., W. Xian, and C. F. Moss. (2008). Flying in silence: echolocating bats cease vocalizing to avoid sonar jamming. *Proceedings of the National Academy of Sciences, 105*(35), 13116–13121.

Clark, K. E., L. J. Niles, and J. Burger. (1993). Abundance and distribution of migrant shorebirds in Delaware Bay. *Condor, 95*(3), 694–705.

Clavero, M., L. Brotons, P. Pons, and D. Sol. (2009). Prominent role of invasive species in avian biodiversity loss. *Biological Conservation, 142*(10), 2043–2049.

Cohen, J. B., and C. Gratto-Trevor. (2011). Survival, site fidelity, and the population dynamics of piping plovers in Saskatchewan. *Journal of Field Ornithology, 82*(4), 379–394.

Congdon, B. C., C. A. Erwin, D. R. Peck, G. B. Baker, M. C. Double, and P. O'Neill. (2007). Vulnerability of seabirds on the Great Barrier Reef to climate change. In J. E. Johnson & P. A. Marshall (Eds.), *Climate Change and the Great Barrier Reef: A Vulnerability Assessment* (pp. 427–463). Townsville, Australia: Great Barrier Reef Marine Park Authority and Australian Greenhouse Office.

Conner, W. E., and A. J. Corcoran. (2012). Sound strategies: the 65-million-year-old battle between bats and insects. *Annual Review of Entomology, 57*, 21–39.

Conomy, J. T., J. A. Dubovsky, J. A. Collazo, and W. J. Fleming. (1998). Do black ducks and wood ducks habituate to aircraft disturbance? *Journal of Wildlife Management, 62*(3), 1135–1142.

Constantine, D. (2003). Geographic translocation of bats: Known and potential problems. *Emerging Infectious Diseases, 9*(1), 17–21.

Cook, T. R., M. Hamann, L. Pichegru, F. Bonadonna, D. Grémillet, and P. G. Ryan. (2011). GPS and time-depth loggers reveal underwater foraging plasticity in a flying diver, the Cape Cormorant. *Marine Biology, 159*(2), 373–387.

Corcoran, A. J., J. R. Barber, and W. E. Conner. (2009). Tiger moth jams bat sonar. *Science, 325,* 325–327.

Cornell Lab of Ornithology. (2002). *Red Phalarope: Phalaropus fulicarius*. *Birds of North America.* Retrieved from https://birdsna.org/Species-Account/bna/species/redpha1/introduction.

Cornell Lab of Ornithology. (2009). *All About Birds. Sandpipers, Phalaropes, and Allies (Order: Charadiiformes, Family: Scolopacidae)*. Retrieved from http://www.allaboutbirds.org/guide/browse_tax.aspx?family=53.

Cornell Lab of Ornithology. (2011). *All About Birds. Peregrine Falcon*. Retrieved from http://www.allaboutbirds.org/guide/Peregrine_Falcon/id?gclid=CLK8m7eW4KoCFQfd4AoduAzf6A.

Cornell Lab of Ornithology. (2013). *Red Knot: Calidris canutus*. *Birds of North America.* Retrieved from https://birdsna.org/Species-Account/bna/species/563/articles/introduction.

Cornell Lab of Ornithology. (2014). *Roseate Tern (Sterna dougallii)*. *Birds of North America.* Retrieved from https://birdsna.org/Species-Account/bna/species/370/articles/introduction.

Crowell, S. C. (2016). Measuring in-air and underwater hearing in seabirds. *Advances in Experimental Medicine and Biology, 875*, 1155–1160.

Crowell, S. E., A. M. Wells-Berlin, C. E. Carr, G. H. Olsen, R. E. Therrien, S. E. Ynnuzzi, and D. R. Ketten. (2015). A comparison of auditory brainstem responses across diving bird species. *Journal of Comparative Physiology A, 201*(8), 803–815.

Cryan, P., and A. Brown. (2007). Migration of bats past a remote island offers clues toward the problem of bat fatalities at wind turbines. *Biological Conservation*, 1–11.

Cucurachi, S., W. Tamis, M. Vijver, W. Peijnenburg, J. Bolte, and G. Snoo. (2013). A review of the ecological effects of radiofrequency electromagnetic fields (RF-EMF). *Environmental International, 51*, 116–140.

Damon, E. G., D. R. Richmond, E. R. Fletcher, and R. K. Jones. (1974). *The Tolerance of Birds to Airblast* (Contract Number DASA 01-70-C-0075). Springfield, VA: Lovelace Foundation for Medical Education and Research.

Danil, K., and J. A. St Leger. (2011). Seabird and dolphin mortality associated with underwater detonation exercises. *Marine Technology Society Journal, 45*(6), 89–95.

Davoren, G. K., P. Penton, C. Burke, and W. A. Montevecchi. (2012). Water temperature and timing of capelin spawning determine seabird diets. *ICES Journal of Marine Science, 69*(7), 1234–1241.

Dearborn, D. C., A. D. Anders, and P. G. Parker. (2001). Sexual dimorphism, extrapair fertilizations, and operational sex ratio in great frigatebirds (*Fregata minor*). *Behavioral Ecology, 12*(6), 746–752.

Denzinger, A., and H. U. Schnitzler. (2013). Bat guilds, a concept to classify the highly diverse foraging and echolocation behaviors of microchiropteran bats. *Frontiers in Physiology, 4*, 164.

Desholm, M., A. D. Fox, P. D. L. Beasley, and J. Kahlert. (2006). Remote techniques for counting and estimating the number of bird-wind turbine collisions at sea: A review. *IBIS, 148*, 76–89.

Dietrich, K., and E. Melvin. (2004). *Annotated Bibliography: Seabird Interactions with Trawl Fishing Operations and Cooperative Research* (Washington Sea Grant Program). Seattle, WA: University of Washington Board of Regents.

Dobson, A. (2010). Bird report. *Bermuda Audubon Society Newsletter, 21*(1), 1–11.

Dobson, A. L. F., and J. Madeiros. (2009). Threats facing Bermuda's breeding seabirds: Measures to assist future breeding success. In T. D. Rich, C. Arizmendi, D. W. Demarest, & C. Thompson (Eds.), *Tundra to Tropics: Connecting Birds, Habitats and People: Proceedings of the Fourth International Partners in Flight Conference* (pp. 223–226). Hamilton, Bermuda: Partners in Flight.

Dolbeer, R. A. (2006). *Height Distribution of Birds Recorded by Collisions with Civil Aircraft* (Wildlife Damage Management Internet Center for Publications). Lincoln, Nebraska: U.S. Department of Agriculture Wildlife Services.

Dooling, R. (2002). *Avian Hearing and the Avoidance of Wind Turbines*. College Park, MD: University of Maryland.

Dooling, R. J. (1980). Behavior and Psychophysics of Hearing in Birds. In A. N. Popper & R. R. Fay (Eds.), *Comparative Studies of Hearing in Vertebrates*. New York, NY: Springer-Verlag.

Dooling, R. J., and A. N. Popper. (2000). Hearing in birds and reptiles. In R. J. Dooling, R. R. Fay, & A. N. Popper (Eds.), *Comparative Hearing in Birds and Reptiles* (Vol. 13, pp. 308–359). New York, NY: Springer-Verlag.

Dooling, R. J., and S. C. Therrien. (2012). Hearing in birds: What changes from air to water. *Advances in Experimental Medicine and Biology, 730*, 77–82.

Dove, C. T., and C. Goodroe. (2008). Marbled Godwit Collides with Aircraft at 3,700 M. *The Wilson Journal of Ornithology, 120*(4), 914–915.

Duffy, D. C. (1986). Foraging at patches: interactions between common and roseate terns. *Ornis Scandinavica, 17*(4), 47–52.

Durant, J. M., T. Anker-Nilssen, and N. C. Stenseth. (2003). Trophic interaction under climate fluctuations: The Atlantic puffin as an example. *Proceedings of the Royal Society of London, 270(B)*(1), 461–466.

Ehrlich, P. R., D. S. Dobkin, and D. Wheye. (1988). *The Birder's Handbook: A Field Guide to the Natural History of North American Birds*. New York, NY: Simon & Schuster, Inc.

Elliott-Smith, E., M. Bidwell, A. Holland, and S. Haig. (2015). *Data from the 2011 International Piping Plover Census*. Reston, VA: U.S. Department of the Interior, U.S. Geological Survey.

Ellis, D. H. (1981). *Responses of Raptorial Birds to Low Level Military Jets and Sonic Booms* (Results of the 1980-1981 joint U.S. Air Force-U.S. Fish and Wildlife Service Study). Oracle, AZ: Institute for Raptor Studies.

Ellis, J. C., M. J. Shulman, M. Wood, J. D. Witman, and S. Lozyniak. (2007). Regulation of intertidal food webs by avian predators on New England rocky shores. *Ecology, 88*(4), 853–863.

Elphick, J. (2007). *Atlas of Bird Migration: Tracing the Great Journeys of the World's Birds*. Buffalo, NY: Firefly Books.

Enticott, J., and D. Tipling. (1997). *Seabirds of the World: The Complete Reference* (1st ed.). Mechanicsburg, PA: Stackpole Books.

Erbe, C., C. Reichmuth, K. Cunningham, K. Lucke, and R. Dooling. (2016). Communication masking in marine mammals: A review and research strategy. *Marine Pollution Bulletin, 103*(1–2), 15–38.

Fauchald, P., K. E. Erikstad, and G. H. Systad. (2002). Seabirds and marine oil incidents: is it possible to predict the spatial distribution of pelagic seabirds? *Journal of Applied Ecology, 39*(2), 349–360.

Favero, M., G. Blanco, G. Garcia, S. Copello, J. P. S. Pon, E. Frere, F. Quintana, P. Yorio, F. Rabuffetti, G. Canete, and P. Gandini. (2011). Seabird mortality associated with ice trawlers in the Patagonian shelf: Effect of discards on the occurrence of interactions with fishing gear. *Animal Conservation, 14*(2), 131–139.

Fay, C., M. Bartron, S. Craig, A. Hecht, J. Pruden, R. Saunders, T. Sheehan, and J. Trial. (2006). *Status Review for Anadromous Atlantic Salmon (Salmo salar) in the United States*. Washington, DC: National Marine Fisheries Service and U.S. Fish and Wildlife Service.

Federal Aviation Administration. (2003). *Memorandum of Agreement Between the Federal Aviation Administration, the U.S. Air Force, the U.S. Army, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, and the U.S. Department of Agriculture to Address Aircraft-Wildlife Strikes*. Washington, DC: Federal Aviation Administration.

Federal Emergency Management Agency. (2012). *Draft Environmental Assessment for Canaveral Port Authority Port Wide Interoperable Communications Infrastructure Project Cape Canaveral, Brevard County, Florida*. Atlanta, GA: U.S. Department of Homeland Security, Federal Emergency Management Agency.

Finneran, J. J. (2015). Noise-induced hearing loss in marine mammals: A review of temporary threshold shift studies from 1996 to 2015. *The Journal of the Acoustical Society of America, 138*(3), 1702–1726.

Fisher, H. I. (1971). Experiments on homing in Laysan Albatrosses, *Diomedea immutabilis*. *Condor, 73*(4), 389–400.

Florida Fish and Wildlife Conservation Commission. (2017a). *Bald Eagle: General Information*. Retrieved from http://myfwc.com/wildlifehabitats/managed/baldeagle/information/.

Florida Fish and Wildlife Conservation Commission. (2017b). *Florida Bonneted Bat (Eumops floridanus)*. Retrieved from http://myfwc.com/wildlifehabitats/profiles/mammals/land/bats/information/field-guide/florida-bonneted-bat/.

Florida Fish and Wildlife Conservation Commission. (2017c). *Gray Bat (Myotis grisescens)*. Retrieved from http://myfwc.com/wildlifehabitats/profiles/mammals/land/bats/information/field-guide/gray-bat/.

Gall, S., and R. Thompson. (2015). The impact of debris on marine life. *Marine Pollution Bulletin, 92*, 170–179.

Gauthreaux, S. A., and C. G. Belser. (2003). Radar ornithology and biological conservation. *Auk, 120*(2), 266–277.

Gehring, J., P. Kerlinger, and A. M. Manville, II. (2009). Communication towers, lights, and birds: Successful methods of reducing the frequency of avian collisions. *Ecological Applications, 19*(2), 505–514.

Gill, F. B. (1995). *Ornithology* (2nd ed.). New York, NY: W.H. Freeman and Company.

Gochfeld, M. (1983). The roseate tern: World distribution and status of a threatened species. *Biological Conservation, 25*, 103–125.

Gonzalez-Terrazas, T. P., J. C. Koblitz, T. H. Fleming, R. A. Medellín, E. K. Kalko, H. U. Schnitzler, and M. Tschapka. (2016). How nectar-feeding bats localize their food: Echolocation behavior of *leptonycteris yerbabuenae* approaching cactus flowers. *PLoS ONE, 11*(9), e0163492.

Goodwin, S. E., and J. Podos. (2013). Shift of song frequencies in response to masking tones. *Animal Behaviour, 85*, 435–440.

Goudie, R. I., and I. L. Jones. (2004). Dose-response relationships of harlequin duck behavior to noise from low-level military jet over-flights in central Labrador. *Environmental Conservation, 31*(4), 289–298.

Gratto-Trevor, C., D. Amirault-Langlais, D. Catlin, F. Cuthbert, J. Fraser, S. Maddock, E. Roche, and F. Shaffer. (2012). Connectivity in piping plovers: Do breeding populations have distinct winter distributions? *The Journal of Wildlife Management, 76*(2), 348–355.

Greene, G. D., F. R. Engelhardt, and R. J. Paterson. (1985). *Proceedings of the Workshop on Effects of Explosives Use in the Marine Environment*. Aberdeen, Canada: Canada Oil and Gas Lands Administration, Environmental Protection Branch.

Griffin, D. R., J. J. G. McCue, and A. D. Grinnell. (1962). The resistance of bats to jamming. *Journal of Experimental Zoology*(285), 1–34.

Grubb, T. G., D. K. Delaney, W. W. Bowerman, and M. R. Wierda. (2010). Golden eagle indifference to heli-skiing and military helicopters in northern Utah. *Journal of Wildlife Management, 74*(6), 1275–1285.

Haftorn, S., F. Mehlum, and C. Bech. (1988). Navigation to nest site in the snow petrel (*Pagodroma nivea*). *The Condor, 90*(2), 484–486.

Hage, S. R., T. Jiang, S. W. Berquist, J. Feng, and W. Metzner. (2013). Ambient noise induces independent shifts in call frequency and amplitude within the Lombard effect in echolocating bats. *Proceedings of the National Academy of Sciences, 110*(10), 4063–4068.

Haig, S. M., and E. Elliott-Smith. (2004). *Piping Plover*. *The Birds of North America.* Retrieved from http://bna.birds.cornell.edu/bna/species.

Hamilton, W. J., III. (1958). Pelagic birds observed on a North Pacific crossing. *The Condor, 60*(3), 159–164.

Haney, J., H. Geiger, and J. Short. (2014a). Bird mortality from the Deepwater Horizon oil spill. II: Carcass sampling and exposure probability in the coastal Gulf of Mexico. *Marine Ecology Progress Series, 513*, 239–252.

Haney, J., H. Geiger, and J. Short. (2014b). Bird mortality from the Deepwater Horizon oil spill. I: Exposure probability in the offshore Gulf of Mexico. *Marine Ecology Progress Series, 513*, 225–237.

Haney, J. C. (1986a). Seabird patchiness in tropical oceanic waters: The influence of *Sargassum* "reefs". *The Auk, 103*(1), 141–151.

Haney, J. C. (1986b). Seabird segregation at Gulf Stream frontal eddies. *Marine Ecology Progress Series, 28*, 279–285.

Hanlon, R. T., and J. B. Messenger. (1996). *Cephalopod Behaviour*. Cambridge, United Kingdom: Cambridge University Press.

Hansen, K. A., A. Maxwell, U. Siebert, O. N. Larsen, and M. Wahlberg. (2017). Great cormorants (*Phalacrocorax carbo*) can detect auditory cues while diving. *The Science of Nature, 104*(5–6), 45.

Harrison, P. (1983). *Seabirds, an Identification Guide*. Boston, MA: Houghton Mifflin Company.

Hashino, E., M. Sokabe, and K. Miyamoto. (1988). Frequency specific susceptibility to acoustic trauma in the buderigar (*Melopsittacus undulatus*). *The Journal of the Acoustical Society of America, 83*(6), 2450–2453.

Hatch, J., and P. Kerlinger. (2004). *Appendix 5.7-H Evaluation of the Roseate Tern and Piping Plover for the Cape Wind Project Nantucket Sound*. Sandwich, MA: ESS Group, Inc.

Hatch, S. K., E. E. Connelly, T. J. Divoll, I. J. Stenhouse, and K. A. Williams. (2013). Offshore observations of Eastern red bats (*Lasiurus borealis*) in the mid-Atlantic United States using multiple survey methods. *PLoS ONE, 8*(12), e83803.

Hayman, D. T. S., J. R. C. Pulliam, J. C. Marshall, P. M. Cryan, and C. T. Webb. (2016). Environment, host, and fungal traits predict continental-scale white-nose syndrome in bats. *Animal Ecology, 2*(e1500831), 1–12.

Henry, P. Y., G. Wey, and G. Balanca. (2011). Rubber band ingestion by a rubbish dump dweller, the white stork (*Ciconia ciconia*). *Waterbirds, 34*(4), 504–508.

Hertel, F., and L. Ballance. (1999). Wing ecomorphology of seabirds from Johnston Atoll. *The Condor, 101*, 549–556.

Hetherington, T. (2008). Comparative anatomy and function of hearing in aquatic amphibians, reptiles, and birds. In J. G. M. Thewissen & S. Nummela (Eds.), *Sensory Evolution on the Threshold* (pp. 182–209). Berkeley, CA: University of California Press.

Hillman, M. D., S. M. Karpanty, J. D. Fraser, and A. Derose-Wilson. (2015). Effects of aircraft and recreation on colonial waterbird nesting behavior. *Journal of Wildlife Management, 79*(7), 1192–1198.

Hiryu, S., M. E. Bates, J. A. Simmons, and H. Riquimaroux. (2010). FM echolocating bats shift frequencies to avoid broadcast-echo ambiguity in clutter. *Proceedings of the National Academy of Sciences, 107*(15), 7048–7053.

Holland, R. A., K. Thorup, M. J. Vonhof, W. W. Cochran, and M. Wikelski. (2006). Navigation: Bat orientation using Earth's magnetic field. *Nature, 444*(7120), 702.

Holland, R. A., J. L. Kirschvink, T. G. Doak, and M. Wikelski. (2008). Bats use magnetite to detect the earth's magnetic field. *PLoS ONE, 3*(2), e1676.

Hom, K. N., M. Linnenschmidt, J. A. Simmons, and A. M. Simmons. (2016). Echolocation behavior in big brown bats is not impaired after intense broadband noise exposures. *The Journal of Experimental Biology, 219*(20), 3253–3260.

Hotchkin, C., and S. Parks. (2013). The Lombard effect and other noise-induced vocal modifications: Insight from mammalian communication systems. *Biological Reviews of the Cambridge Philosophical Society, 88*(4), 809–824.

Hyrenbach, K. (2001). Albatross response to survey vessels: Implications for studies of the distribution, abundance, and prey consumption of seabird populations. *Marine Ecology Progress Series, 212*, 283–295.

Hyrenbach, K. (2006). *Training and Problem-Solving to Address Population Information Needs for Priority Species, Pelagic Species and Other Birds at Sea*. Paper presented at the Waterbird Monitoring Techniques Workshop, IV North American Ornithological Conference. Veracruz, Mexico.

International Union for Conservation of Nature. (2017). *Leporillus conditor*. Retrieved from http://www.iucnredlist.org/details/11634/0.

International Union for Conservation of Nature and Natural Resources. (2010a). *Phoebastria albatrus*. *International Union for Conservation of Nature 2010. International Union for Conservation of Nature Red List of Threatened Species. Version 2010.3.* Retrieved from http://www.iucnredlist.org.

International Union for Conservation of Nature and Natural Resources. (2010b). *Pterodroma cahow*. *International Union for Conservation of Nature Red List of Threatened Species. Version 2010.4.* Retrieved from http://www.iucnredlist.org/.

Jakobsen, L., S. Brinkløv, and A. Surlykke. (2013). Intensity and directionality of bat echolocation signals. *Frontiers in Physiology, 4*, 1–9.

Jensen, M. E., C. F. Moss, and A. Surlykke. (2005). Echolocating bats can use acoustic landmarks for spatial orientation. *The Journal of Experimental Biology, 208*(23), 4399–4410.

Jessup, D. A., M. A. Miller, J. P. Ryan, H. M. Nevins, H. A. Kerkering, A. Mekebri, D. B. Crane, T. A. Johnson, and R. M. Kudela. (2009). Mass stranding of marine birds caused by a surfactant-producing red tide. *PLoS ONE, 4*(2), e4550.

Jiménez, S., A. Domingo, M. Abreu, and A. Brazeiro. (2012). Bycatch susceptibility in pelagic longline fisheries: Are albatrosses affected by the diving behaviour of medium-sized petrels? *Aquatic Conservation: Marine and Freshwater Ecosystems, 22*(4), 436–445.

Johansen, S., O. N. Larsen, J. Christensen-Dalsgaard, L. Seidelin, T. Huulvej, K. Jensen, S. G. Lunneryd, M. Bostrom, and M. Wahlberg. (2016). In-air and underwater hearing in the great cormorant (*Phalacrocorax carbo sinensis*). *Advances in Experimental Medicine Biology, 875*, 505–512.

Johnson, C. L., and R. T. Reynolds. (2002). *Responses of Mexican Spotted Owls to Low-Flying Military Jet Aircraft*. Fort Collins, CO: U.S. Department of Agriculture.

Johnson, J., J. Gates, and N. Zegre. (2011). Monitoring seasonal bat activity on a coastal barrier island in Maryland, USA. *Environmental Monitoring and Assessment, 173*, 685–699.

Johnson, R. J., P. H. Cole, and W. W. Stroup. (1985). Starling response to three auditory stimuli. *Journal of Wildlife Management, 49*(3), 620–625.

Jones, I. L. (2001). Auks. In C. Elphick, J. B. Dunning, Jr., & D. A. Sibley (Eds.), *The Sibley Guide to Bird Life and Behavior* (pp. 309–318). New York, NY: Alfred A. Knopf, Inc.

Jones, J., J. Smith, and H. Genoways. (1973). Annotated Checklist of Mammals of the Yucatan Peninsula, Mexico. I. Chiroptera. *Occasional Papers, Museum of Texas Tech University*(13), 1–32.

Kain, E., J. Lavers, C. Berg, A. Raine, and A. Bond. (2016). Plastic ingestion by Newell's (*Puffinus newelli*) and wedge-tailed shearwaters (*Ardenna pacifica*) in Hawaii. *Environmental Science and Pollution Research*, 1–9.

Kalko, E. K. V., and H. U. Schnitzler. (1998). How Echolocating Bats Approach and Acquire Food. In T. H. Kunz & P. A. Racey (Eds.), *Bat Biology and Conservation* (pp. 197–204). Washington, DC: Smithsonian Institution Press.

Karpouzi, V. S., R. Watson, and D. Pauly. (2007). Modeling and mapping resource overlap between seabirds and fisheries on a global scale: A preliminary assessment. *Marine Ecology Progress Series, 343*, 87–99.

Kastelein, R. A., S. van der Heul, W. C. Verboom, N. Jennings, J. van der Veen, and D. de Haan. (2008). Startle response of captive North Sea fish species to underwater tones between 0.1 and 64 kHz. *Marine Environmental Research, 65*(5), 369–377.

Kaufman, K. (1990). *The Peterson Field Guide Series, A Field Guide to Advanced Birding: Birding Challenges and How to Approach Them*. Boston, MA: Houghton Mifflin Company.

Kazial, K. A., and M. W. Masters. (2004). Female big brown bats, *Eptesicus fuscus*, recognize sex from a caller's echolocation signals. *Animal Behaviour, 67*, 855–863.

Kerlinger, P. (2009). *How Birds Migrate* (2nd ed.). Mechanicsburg, PA: Stackpole Books.

Kight, C. R., S. S. Saha, and J. P. Swaddle. (2012). Anthropogenic noise is associated with reductions in the productivity of breeding Eastern Bluebirds (*Sialia sialis*). *Ecological Applications, 22*(7), 1989–1996.

Kirkham, I. R., and D. N. Nettleship. (1987). Status of the roseate tern in Canada. *Journal of Field Ornithology, 58*(4), 505–515.

Knight, R. L., and S. A. Temple. (1986). Why does intensity of avian nest defense increase during the nesting cycle? *The Auk, 103*(2), 318–327.

Knopf, F. L., and R. M. Evans. (2004). American White Pelican (*Pelecanus erythrorhynchos*). *The Birds of North America Online, 57*, 6.

Koay, G., H. E. Heffner, and R. S. Heffner. (1997). Audiogram of the big brown bat (*Eptesicus fuscus*). *Hearing Research, 105*, 202–210.

Komenda-Zehnder, S., M. Cevallos, and B. Bruderer. (2003). *Effects of disturbance by aircraft overflight on waterbirds–an experimental approach* (International Bird Strike Committee). Sempach, Switzerland: Swiss Ornithological Institute.

Kujawa, S. G., and M. C. Liberman. (2009). Adding insult to injury: Cochlear nerve degeneration after "temporary" noise-induced hearing loss. *The Journal of Neuroscience, 29*(45), 14077–14085.

Kunz, T. (2017). *Bat Facts and Folklore*. Retrieved from https://www.bu.edu/cecb/bat-lab-update/bats/bat-facts-and-folklore/.

Lacroix, D. L., R. B. Lanctot, J. A. Reed, and T. L. McDonald. (2003). Effect of underwater seismic surveys on molting male long-tailed ducks in the Beaufort Sea, Alaska. *Canadian Journal of Zoology, 81*, 1862–1875.

Larkin, R. P., L. L. Pater, and D. J. Tazlk. (1996). *Effects of Military Noise on Wildlife: A Literature Review* (USACERL Technical Report 96/21). Champaign, IL: Department of the Army, Construction Engineering Research Lab.

Lee, D. S. (1987). December records of seabirds off North Carolina. *The Wilson Bulletin, 99*(1), 116–121.

Lee, D. S., and W. A. Mackin. (2008). *Bermuda Petrel*. Retrieved from http://wicbirds.net/index.html.

Lin, H. W., A. C. Furman, S. G. Kujawa, and M. C. Liberman. (2011). Primary neural degeneration in the guinea pig cochlea after reversible noise-induced threshold shift. *Journal of the Association for Research in Otolaryngology, 12*(5), 605–616.

Lin, J. (2002). *Alca torda: Animal diversity web*. Retrieved from http://animaldiversity.ummz.umich.edu/accounts/Alca_torda/.

Lincoln, F. C., S. R. Perterson, and J. L. Zimmerman. (1998). *Migration of Birds* (Migration of Birds Circular 16). Manhattan, KS: U.S. Department of the Interior, U.S. Fish & Wildlife Service.

Lott, C. A. (2006). A new raptor migration monitoring site in the Florida Keys: Counts from 1999—2004. *Journal of Raptor Research, 40*(3), 200–209.

Luo, J., K. Koselj, S. Zsebok, B. Siemers, and H. Goerlitz. (2013). Global warming alters sound transmission: Differential impact on the prey detection ability of echolocating bat. *Journal of the Royal Society Interface, 11*(20130961), 1–10.

Luo, J., and L. Wiegrebe. (2016). Biomechanical control of vocal plasticity in an echolocating bat. *The Journal of Experimental Biology, 219*(6), 878–886.

Madeiros, J. (2009). Cahow update. *Bermuda Audubon Society Newsletter, 20*(2), 2.

Madeiros, J., N. Carlile, and D. Priddel. (2012). Breeding biology and population increase of the endangered Bermuda petrel, *Pterodroma cahow*. *Bird Conservation International, 22*(1), 35–45.

Manci, K. M., D. N. Gladwin, R. Villella, and M. G. Cavendish. (1988). *Effects of Aircraft Noise and Sonic Booms on Domestic Animals and Wildlife: A Literature Synthesis* (NERC-88/29). Fort Collins, CO: U.S. Fish and Wildlife Service, National Ecology Research Center.

Manning, R., C. Jones, and F. Yancey. (2008). Annotated Checklist of Recent Land Mammals of Texas, 2008. *Occasional Papers, Museum of Texas Tech University*(278), 1–20.

Manville, A. (2016). *A Briefing Memorandum: What We Know, Can Infer, and Don't Yet Know about Impacts from Thermal and Non-thermal Non-ionizing Radiation to Birds and Other Wildlife—for Public Release*. Washington, DC: U.S. Fish and Wildlife Service.

Maslo, B., J. Burger, and S. N. Handel. (2012). Modeling foraging behavior of piping plovers to evaluate habitat restoration success. *The Journal of Wildlife Management, 76*(1), 181–188.

Masters, W. M., K. A. S. Raver, and K. A. Kazial. (1995). Sonar signals of big brown bats, *Eptesicus fuscus*, contain information about individual identity, age and family affiliation. *Animal Behaviour, 50*(5), 1243–1260.

Maxwell, A., K. A. Hansen, S. T. Ortiz, O. N. Larsen, U. Siebert, and M. Wahlberg. (2017). In-air hearing of the great cormorant (*Phalacrocorax carbo*). *Biology Open, 6*(4), 496–502.

McAlexander, A. (2013). *Evidence that Bats Perceive Wind Turbine Surfaces to be Water.* (master's thesis). Texas Christian University, Fort Worth, TX. Retrieved from https://repository.tcu.edu.

Melvin, E., and J. Parrish. (2001). *Seabird Bycatch: Trends, Roadblocks, and Solutions, February 26-27, 1999.* Paper presented at the Annual Meeting of the Pacific Seabird Group, Blaine, WA.

Melvin, E. F., J. K. Parrish, and L. L. Conquest. (1999). Novel tools to reduce seabird bycatch in coastal gillnet fisheries; Nuevas herramientas para reducir la captura accidental de aves marinas con redes agalleras de pesquerías costeras. *Conservation Biology, 13*(6), 1386–1397.

Melvin, E. F., J. K. Parrish, K. S. Dietrich, and O. S. Hamel. (2001). *Solutions to Seabird Bycatch in Alaska's Demersal Longline Fisheries*. Seattle, WA: Washington Sea Grant Program.

Melvin, E. F., K. S. Dietrich, S. Fitzgerald, and T. Cardoso. (2011). Reducing seabird strikes with trawl cables in the pollock catcher-processor fleet in the eastern Bering Sea. *Polar Biology, 34*(2), 215–226.

Merkel, F. R., and K. L. Johansen. (2011). Light-induced bird strikes on vessels in Southwest Greenland. *Marine Pollution Bulletin, 62*(11), 2330–2336.

Meyer, K. D., S. M. McGehee, and M. W. Collopy. (2004). Food deliveries at swallow-tailed kite nests in southern Florida. *Condor, 106*(1), 171–176.

Miller, L. A., V. Futtrup, and D. C. Dunning. (2004). How Extrinsic Sounds Interfere with Bat Biosonar. In J. A. Thomas, C. F. Moss, & M. Vater (Eds.), *Echolocation in Bats and Dolphins* (pp. 380–385). Chicago, IL: University of Chicago Press.

Mintz, J. D. (2012). *Vessel Traffic in the Hawaii-Southern California and Atlantic Fleet Testing and Training Study Areas*. (CRM D0026186.A2/Final). Alexandria, VA: Center for Naval Analyses.

Mistry, S., and A. Moreno-Valdez. (2008). Climate change and bats: Vampire bats offer clues to the future. *BATS Magazine, 26*(2), 1–4.

Moser, M. L., and D. S. Lee. (1992). A fourteen-year survey of plastic ingestion by western north Atlantic seabirds. *Colonial Waterbirds, 15*(1), 83–94.

Moss, C. F., C. Chiu, and A. Surlykke. (2011). Adaptive vocal behavior drives perception by echolocation in bats. *Current Opinion in Neurobiology, 21*(4), 645–652.

Mostello, C. S. (2007). *Common Tern Sterna hirundo*. Westborough, MA: Massachusetts Division of Fisheries and Wildlife.

Mowbray, T. B., C. R. Ely, J. S. Sedinger, and R. E. Trost. (2002). *Canada Goose (Branta canadensis)*. *The Birds of North America Online.* Retrieved from Birds of North America Online: http://bna.birds.cornell.edu/bna/species/682.

Murphy, R. C., and L. Mowbray. (1951). New light on the Cahow, *Pterodrama cahow*. *The Auk, 68*(3), 266–280.

National Audubon Society. (2005). *Bermuda Petrel, Pterodroma cahow*. *Bird Conservation, Waterbird Conservation, Waterbird Species.* Retrieved from http://web1.audubon.org/waterbirds/species.php?speciesCode=berpet.

National Audubon Society. (2015). *Important Bird Areas Program: A Global Currency for Bird Conservation*. Retrieved from http://web4.audubon.org/bird/iba/.

National Audubon Society. (2017). *Guide to North American Birds: Roseate Tern*. Retrieved from http://www.audubon.org/field-guide/bird/roseate-tern.

National Marine Fisheries Service, and U.S. Fish and Wildlife Service. (2005). *Final Recovery Plan for the Gulf of Maine Distinct Population Segment of Atlantic Salmon (Salmo salar)*. Silver Spring, MD: National Marine Fisheries Service.

National Oceanic and Atmospheric Administration. (2016). *Discover the Issue: Marine Debris*. Retrieved from https://marinedebris.noaa.gov/discover-issue.

National Park Service. (1994). *Report on Effects of Aircraft Overflights on the National Park System* (Report to Congress prepared pursuant to Public Law 100-191, the National Parks Overflights Act of 1987). Washington, DC: National Park Service.

National Park Service. (2017a). *Hibernate or Migrate*. Retrieved from https://www.nps.gov/subjects/bats/hibernate-or-migrate.htm.

National Park Service. (2017b). *Night Flyers: Desert Pollinator Bats*. Retrieved from https://www.nps.gov/subjects/pollinators/migratingbats.htm.

Naval Air Station Jacksonville. (2012). *Bird Aircraft Strike Hazard (BASH) Reduction Program*. Jacksonville, FL: U.S. Department of the Navy.

Naval Safety Center. (2017). *Web-Enabled Safety System, Bird/Animal Aircraft Strike Statistics, 2006-2015*. Retrieved from http://www.public.navy.mil/NAVSAFECEN/Pages/WESS/index.aspx.

Nevitt, G., and R. Veit. (1999). *Mechanisms of preypatch detection by foraging seabirds*. Paper presented at the 22nd International Ornithological Congress. Durban, South Africa.

Newton, I. (2007). Weather-related mass-mortality events in migrants. *IBIS, 149*(3), 453–467.

Nicholls, B., and P. A. Racey. (2007). Bats avoid radar installations: Could electromagnetic fields deter bats from colliding with wind turbines? *PLoS ONE, 2*(3), e297.

Nicholls, B., and P. A. Racey. (2009). The aversive effect of electromagnetic radiation on foraging bats: A possible means of discouraging bats from approaching wind turbines. *PLoS ONE, 4*(7), e6246.

Niemiec, A. J., Y. Raphael, and D. B. Moody. (1994). Return of auditory function following structural regeneration after acoustic trauma: Behavioral measures from quail. *Hearing Research, 75*, 209–224.

Niles, L. J., H. P. Sitters, A. D. Dey, P. W. Atkinson, A. J. Baker, K. A. Bennett, R. Carmona, K. E. Clark, N. A. Clark, C. Espoz, P. M. González, B. A. Harrington, D. E. Hernández, K. S. Kalasz, R. G. Lathrop, R. N. Matus, C. D. T. Minton, R. I. G. Morrison, M. K. Peck, W. Pitts, R. A. Robinson, and I. L. Serrano. (2008). *Status of the Red Knot (Calidris canutus rufa) in the Western Hemisphere* (Studies in Avian Biology). Boise, ID: Cooper Ornithological Society.

Nisbet, I. C. T., and J. A. Spendelow. (1999). Contribution of research to management and recovery of the roseate tern: Review of a twelve-year project. *Waterbirds: The International Journal of Waterbird Biology, 22*(2), 239–252.

Noirot, I. C., E. F. Brittan-Powell, and R. J. Dooling. (2011). Masked auditory thresholds in three species of birds, as measured by the auditory brainstem response. *The Journal of the Acoustical Society of America, 129*(6), 3445–3448.

North American Bird Conservation Initiative, and U.S. Committee. (2010). *The State of the Birds: 2010 Report on Climate Change, United States of America*. Washington, DC: U.S. Department of the Interior.

North American Bird Conservation Initiative U.S. Committee. (2009). *The State of the Birds, United States of America, 2009*. Washington, DC: U.S. Department of Interior. Retrieved from http://www.stateofthebirds.org/pdf_files/State_of_the_Birds_2009.pdf.

O'Brien, M., R. Crossley, and K. Karlson. (2006). Piping plover: *Charadrius melodus*. In *The Shorebird Guide* (pp. 54–56, 335–337). New York, NY: Houghton Mifflin Company.

Olsen, K. M., and H. Larsson. (1995). *Terns of Europe and North America*. Princeton, NJ: Princeton University Press.

Onley, D., and P. Scofield. (2007). *Albatrosses, Petrels and Shearwaters of the World*. Princeton, NJ: Princeton University Press.

Partecke, J., I. Schwabl, and E. Gwinner. (2006). Stress and the city: Urbanization and its effects on the stress physiology in european blackbirds. *Ecology, 87*(8), 1945–1952.

Patricelli, G. L., and J. L. Blickley. (2006). Avian communication in urban noise: Causes and consequences of vocal adjustment. *The Auk, 123*(3), 639–649.

Pelletier, S. K., K. Omland, K. S. Watrous, and T. S. Peterson. (2013). *Information Synthesis on the Potential for Bat Interactions with Offshore Wind Facilities–Final Report* (U.S. Dept of the Interior, Bureau of Ocean Energy Management, Headquarters, Herndon, VA. Outer Continental Shelf Study Bureau of Energy Management). Herndon, VA: U.S. Department of the Interior.

Perkins, S., T. Allison, A. Jones, and G. Sadoti. (2004). *A Survey of Tern Activity Within Nantucket Sound, Massachusetts, During the 2003 Breeding Season*. Lincoln, MA: Massachusetts Audubon Society.

Petrites, A. E., O. S. Eng, D. S. Mowlds, J. A. Simmons, and C. M. DeLong. (2009). Interpulse interval modulation by echolocating big brown bats (*Eptesicus fuscus*) in different densities of obstacle clutter. *Journal of Comparative Physiology A, 195*(6), 603–617.

Piatt, J. F., and N. L. Naslund. (1995). Abundance, distribution, and population status of marbled murrelets in Alaska. In C. J. Ralph, G. L. Hunt, Jr., M. G. Raphael, & J. F. Piatt (Eds.), *Ecology and Conservation of the Marbled Murrelet* (pp. 285–294). Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture.

Pierce, K., R. Harris, L. Larned, and M. Pokras. (2004). Obstruction and starvation associated with plastic ingestion in a northern gannet *Morus bassanus* and a greater shearwater *Puffinus gravis*. *Marine Ornithology, 32*, 187–189.

Piersma, T., R. Hoekstra, A. Dekinga, A. Koolhaas, P. Wolf, P. Battley, and P. Wiersma. (1993). Scale and intensity of intertidal habitat use by knots calidris-canutus in the western Wadden Sea in relation to food, friends and foes. *Netherlands Journal of Sea Research, 31*(4), 331–357.

Placer, J. (1998). The Bats of Puerto Rico. *BATS Magazine, 16*(2), 1–6.

Plumpton, D. (2006). *Review of Studies Related to Aircraft Noise Disturbance of Waterfowl: A Technical Report in Support of the Supplemental Environmental Impact Statement for Introduction of F/A-18 E/F (Super Hornet) Aircraft to the East Coast of the United States*. Norfolk, VA: U.S. Department of the Navy.

Ponganis, P. (2015). *Diving Physiology of Marine Mammals and Seabirds*. Cambridge, United Kingdom: Cambridge University Press.

Poole, A. F., R. O. Bierregaard, and M. S. Martell. (2002). *Osprey (Pandiol haliaetus)*. *The Birds of North America Online.* Retrieved from http://bna.birds.cornell.edu/bna/species/563.

Poot, H., B. J. Ens, H. de Vries, M. A. H. Donners, M. R. Wernand, and J. M. Marquenie. (2008). Green light for nocturnally migrating birds. *Ecology and Society, 13*(2), 47.

Popper, A. N., A. D. Hawkins, R. R. Fay, D. A. Mann, S. M. Bartol, T. J. Carlson, S. Coombs, W. T. Ellison, R. L. Gentry, M. B. Halvorsen, S. Løkkeborg, P. H. Rogers, B. L. Southall, D. G. Zeddies, and W. N. Tavolga. (2014). *ASA S3/SC1.4 TR-2014 Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI*. New York, NY and London, United Kingdom: Acoustical Society of America Press and Springer Briefs in Oceanography.

Pratt, H., P. Bruner, and D. Berrett. (1987). *The Birds of Hawaii and the Tropical Pacific*. Princeton, NJ: Princeton University Press.

Provencher, J., A. Bond, A. Hedd, W. Montevecchi, S. Muzaffar, S. Courchesne, H. Gilchrist, S. Jamieson, F. Merkel, K. Falk, J. Durinck, and M. Mallory. (2014). Prevalence of marine debris in marine birds from the North Atlantic. *Marine Pollution Bulletin, 84*, 411–417.

Pytte, C. L., K. M. Rusch, and M. S. Ficken. (2003). Regulation of vocal amplitude by the blue-throated hummingbird, *Lampornis clemenciae*. *Animal Behaviour, 66*, 703–710.

Razak, K. A., Z. M. Fuzessery, and T. D. Lohuis. (1999). Single cortical neurons serve both echolocation and passive sound localization. *Journal of Neurophysiology, 81*(3), 1438–1442.

Ribic, C. A., S. B. Sheavly, D. J. Rugg, and E. S. Erdmann. (2010). Trends and drivers of marine debris on the Atlantic coast of the United States 1997–2007. *Marine Pollution Bulletin 60*(8), 1231–1242.

Rijke, A. M. (1970). Wettability and phylogenetic development of feather structure in water birds. *The Journal of Experimental Biology, 52*(2), 469–479.

Robertson, G. J., and R. I. Goudie. (1999). Harlequin Duck (*Histrionicus histrionicus*). *The Birds of North America Online*(466), 2.

Rodríguez, A., N. Holmes, P. Ryan, K. Wilson, L. Faulquier, Y. Murillo, A. Raine, J. Penniman, V. Neves, B. Rodríguez, J. Negro, A. Chiaradia, P. Dann, T. Anderson, B. Metzger, M. Shirai, L. Deppe, J. Wheeler, P. Hodum, C. Gouveia, V. Carmo, G. Carreira, L. Delgado-Alburqueque, C. Guerra-Correa, F. Couzi, M. Travers, and M. Le Corre. (2017). A global review of seabird mortality caused by land-based artificial lights. *Conservation Biology*, 1–40.

Rollins, K. E., D. K. Meyerholz, G. D. Johnson, A. P. Capparella, and S. S. Loew. (2012). A forensic investigation into the etiology of bat mortality at a wind farm: Barotrauma or traumatic injury? *Veterinary Pathology, 49*(2), 362–371.

Ronconi, R. (2001). *Cepphus grylle, black guillemot*. *Animal Diversity Web.* Retrieved from http://animaldiversity.ummz.umich.edu/site/accounts/information/Cepphus_grylle.html.

Ronconi, R. A., P. G. Ryan, and Y. Ropert-Coudert. (2010). Diving of great shearwaters (*Puffinus gravis*) in cold and warm water regions of the South Atlantic ocean. *PLoS ONE, 5*(11), e15508.

Root, B. G., M. R. Ryan, and P. M. Mayer. (1992). Piping plover survival in the great-plains. *Journal of Field Ornithology, 63*(1), 10–15.

Rubega, M. A., D. Schamel, D. M. Tracy, A. Poole, and F. Gill. (2000). Red-necked Phalarope (*Phalaropus lobatus*). *The Birds of North America Online*(538), 5.

Rubel, E. W., S. A. Furrer, and J. S. Stone. (2013). A brief history of hair cell regeneration research and speculations on the future. *Hearing Research, 297*, 42–51.

Russel, W. A., Jr., N. D. Lewis, and B. T. Brown. (1996). The impact of impulsive noise on bald eagles at Aberdeen Proving Ground, Maryland. *The Journal of the Acoustical Society of America, 99*(4), 2576–2603.

Ryals, B. M., R. J. Dooling, E. Westbrook, M. L. Dent, A. MacKenzie, and O. N. Larsen. (1999). Avian species differences in susceptibility to noise exposure. *Hearing Research, 131*, 71–88.

Sade, J., Y. Handrich, J. Bernheim, and D. Cohen. (2008). Pressure equilibration in the penguin middle ear. *Acta Oto-Laryngologica, 128*(1), 18–21.

Saunders, J. C., and R. Dooling. (1974). Noise-induced threshold shift in the parakeet (*Melopsittacus undulatus*). *Proceedings of the National Academy of Sciences, 71*(5), 1962–1965.

Savoca, M. (2016). *Plastic Garbage Chemical Attracts Hungry Seabirds*. Retrieved from https://www.scientificamerican.com/article/plastic-garbage-chemical-attracts-hungry-seabirds/.

Savoca, M., M. Wohlfeil, S. Ebeler, and G. Nevitt. (2016). Marine plastic debris emits a keystone infochemical for olfactory foraging seabirds. *Science Advances, 2*(e1600395), 1–9.

Schaub, A., J. Ostwald, and B. M. Siemers. (2008). Foraging bats avoid noise. *The Journal of Experimental Biology, 211*(19), 3174–3180.

Scheuhammer, A. (1987). The chronic toxicity of aluminium, cadmium, mercury, and lead in birds: A review. *Environmental Review, 46*, 263–295.

Schneider, D. C., and D. C. Duffy. (1985). Scale-dependent variability in seabird abundance. *Marine Ecology - Progress Series, 25*, 211–218.

Schnitzler, H. U., C. F. Moss, and A. Denzinger. (2003). From spatial orientation to food acquisition in echolocating bats. *Trends in Ecology and Evolution, 18*(8), 386–394.

Schreiber, R., and J. Chovan. (1986). Roosting by pelagic seabirds: Energetic, populational, and social considerations. *The Condor, 88*, 487–492.

Schueck, L. S., J. M. Marzluff, and K. Steenhof. (2001). Influence of military activities on raptor abundance and behavior. *The Condor, 103*(3), 606–615.

Schwemmer, P., B. Mendel, N. Sonntag, V. Dierschke, and S. Garthe. (2011). Effects of ship traffic on seabirds in offshore waters: Implications for marine conservation and spatial planning. *Ecological Applications, 21*(5), 1851–1860.

Shackelford, C., E. Rozenburg, W. Hunter, and M. Lockwood. (2005). *Migration and the Migratory Birds of Texas: Who They Are and Where They Are Going* (Fourth ed.). Austin, TX: Texas Parks and Wildlife.

Shields, M., A. Poole, and F. Gill. (2002). Brown Pelican (Pelecanus occidentalis). *The Birds of North America Online*(609), 5.

Sibley, D. (2014). *The Sibley Guide to Birds* (Second ed.). New York, NY: Alfred A. Knopf.

Siegel-Causey, D., and S. Kharitonov. (1990). The evolution of coloniality. *Current Ornithology, 7*, 285–330.

Siemers, B. M., and H. U. Schnitzler. (2004). Echolocation signal reflect niche differentiation in five sympatric congeneric bat species. *Nature, 429*, 657–661.

Siemers, B. M., and A. Schaub. (2011). Hunting at the highway: Traffic noise reduces foraging efficiency in acoustic predators. *Proceedings of the Royal Society of London B: Biological Sciences, 278*(1712), 1646–1652.

Sievert, P. R., and L. Sileo. (1993). The effects of ingested plastic on growth and survival of albatross chicks. In K. Vermeer, K. T. Briggs, K. H. Morgan, & D. Siegel-Causey (Eds.), *The Status, Ecology, and Conservation of Marine Birds of the North Pacific* (pp. 212–217). Ottawa, Canada: Canadian Wildlife Service Special Publication.

Simmons, A. M., S. Boku, H. Riquimaroux, and J. A. Simmons. (2015). Auditory brainstem responses of Japanese house bats (*Pipistrellus abramus*) after exposure to broadband ultrasonic noise. *The Journal of the Acoustical Society of America, 138*(4), 2430–2437.

Simmons, A. M., K. N. Hom, M. Warnecke, and J. A. Simmons. (2016). Broadband noise exposure does not affect hearing sensitivity in big brown bats (*Eptesicus fuscus*). *The Journal of Experimental Biology, 219*(7), 1031–1040.

Simmons, J. A., S. A. Kick, A. J. M. Moffat, M. W. Masters, and D. Kon. (1988). Clutter interference along the target range axis in the echolocating bat, *Eptesicus fuscus*. *The Journal of the Acoustical Society of America, 84*(2), 551–559.

Simmons, J. A., K. M. Eastman, S. S. Horowitz, M. J. O'Farrell, and D. N. Lee. (2001). Versatility of biosonar in the big brown bat, *Eptesicus fuscus*. *Acoustics Research Letters Online, 2*(1), 43–48.

Sjollema, A. L., J. E. Gates, R. H. Hilderbrand, and J. Sherwell. (2014). Offshore activity of bats along the Mid-Atlantic Coast. *Northeastern Naturalist, 21*(2), 154–163.

Slabbekoorn, H., and A. den Boer-Visser. (2006). Cities change the songs of birds. *Current Biology, 16*(23), 2326–2331.

Smotherman, M., M. Knornschild, G. Smarsh, and K. Bohn. (2016). The origins and diversity of bat songs. *Journal of Comparative Physiology A, 202*(8), 535–554.

Southall, B. L., A. E. Bowles, W. T. Ellison, J. J. Finneran, R. L. Gentry, C. R. Greene, D. Kastak, D. R. Ketten, J. H. Miller, P. E. Nachtigall, W. J. Richardson, J. A. Thomas, and P. L. Tyack. (2009). Marine mammal noise and exposure criteria: Initial scientific recommendations. *The Journal of the Acoustical Society of America, 125*(4), 2517.

Spatz, D. R., K. M. Newton, R. Heinz, B. Tershy, N. D. Holmes, S. H. Butchart, and D. A. Croll. (2014). The biogeography of globally threatened seabirds and island conservation opportunities. *Conservation Biology, 28*(5), 1282–1290.

Stalmaster, M. V., and J. L. Kaiser. (1997). Flushing responses of wintering bald eagles to military activity. *The Journal of Wildlife Management, 61*(4), 1307–1313.

Stevens, E., and C. Pickett. (1994). Managing the Social Environments of Flamingos for Reproductive Success. *Zoo Biology, 13*, 501–507.

Stilz, W. P., and H. U. Schnitzler. (2012). Estimation of the acoustic range of bat echolocation for extended targets. *The Journal of the Acoustical Society of America, 132*(3), 1765–1775.

Swisdak, M. M., Jr., and P. E. Montanaro. (1992). *Airblast and Fragmentation Hazards Produced by Underwater Explosions*. Silver Spring, MD: Naval Surface Warfare Center.

Taylor, G. A. (2008). Maximum dive depths of eight New Zealand procellariiformes, including pterodroma species. *Papers and Proceedings of the Royal Society of Tasmania, 142*(1), 89–99.

Teer, J. G., and J. C. Truett. (1973). *Studies of the Effects of Sonic Boom on Birds*. Springfield, VA: U.S. Department of Transportation, Federal Aviation Administration.

Tetra Tech Inc. (2014). *Acoustic and Avian Radar Surveys for Birds and Bats NCTAMSLANT DET Cutler, Maine*. Norfolk, VA: Naval Facilities Engineering Command Mid-Atlantic.

Tetra Tech Inc. (2016a). *Bat Baseline Survey Report Joint Expeditionary Base Fort Story Virginia Beach, Virginia*. Norfolk, VA: Naval Facilities Engineering Command Mid-Atlantic.

Tetra Tech Inc. (2016b). *Bat Baseline Survey Report Naval Air Station Oceana Dam Neck Annex Virginia Beach, Virginia*. Norfolk, VA: Naval Facilities Engineering Command Mid-Atlantic.

Tetra Tech Inc. (2016c). *Northern Long-Eared Bat Survey Report Naval Air Station Oceana Virginia Beach, Virginia*. Norfolk, VA: Naval Facilities Engineering Command Mid-Atlantic.

Tetra Tech Inc. (2016d). *Bat Baseline Survey Report Naval Weapons Station Earle Monmouth County, New Jersey*. Norfolk, VA: Naval Facilities Engineering Command Mid-Atlantic,.

Tetra Tech Inc. (2016e). *Pre-Final Integrated Natural Resources Management Plan Naval Station Norfolk & Craney Island Fuel Terminal*. Norfolk, VA: Naval Facilities Engineering Command Mid-Atlantic.

Tetra Tech Inc. (2017a). *Northern Long-Eared Bat Survey Report Naval Station Norfolk and Naval Supply Center Craney Island Fuel Terminal Norfolk and Portsmouth, Virginia*. Norfolk, VA: Naval Facilities Engineering Command Mid-Atlantic.

Tetra Tech Inc. (2017b). *Northern Long-Eared Bat Survey Report Naval Weapons Station Yorktown and Naval Supply Center Cheatham Annex Williamsburg, Virginia*. Norfolk, VA: Naval Facilities Engineering Command Mid-Atlantic.

Therrien, S. C. (2014). *In-air and underwater hearing of diving birds.* (Unpublished doctoral dissertation). University of Maryland, College Park, MD. Retrieved from http://hdl.handle.net/1903/2.

Thiessen, G. J. (1958). Threshold of hearing of a ring-billed gull. *The Journal of the Acoustical Society of America, 30*(11), 1047.

Thompson, R., A. Thompson, and R. Brigham. (2015). A flock of *Myotis* bats at sea. *Northeastern Naturalist, 22*(4), N27–N30.

Ting, C., J. Garrelick, and A. Bowles. (2002). An analysis of the response of Sooty Tern eggs to sonic boom overpressures. *The Journal of the Acoustical Society of America, 111*(1), 562–568.

Titmus, A. J., and K. D. Hyrenbach. (2011). Habitat associations of floating debris and marine birds in the North East Pacific Ocean at coarse and meso spatial scales. *Marine Pollution Bulletin, 62*(11), 2496–2506.

Tsipoura, N., and J. Burger. (1999). Shorebird diet during spring migration stopover on Delaware Bay. *The Condor, 101*, 635–644.

U.S. Air Force. (1997). *Environmental Effects of Self-Protection Chaff and Flares - Final Report*. Langley Air Force Base, VA: U.S. Air Force, Headquarters Air Combat Command.

U.S. Department of Defense. (2009). *Protecting Personnel from Electromagnetic Fields*. (DoD Instruction 6055.11). Washington, DC: Under Secretary of Defense for Acquisition, Technology, and Logistics.

U.S. Department of Energy. (2016). *Long-term Bat Monitoring on Islands, Offshore Structures, and Coastal Sites in the Gulf of Maine, Mid-Atlantic, and Great Lakes—Final Report*. Topsham, ME: Stantec.

U.S. Department of the Navy. (1975). *Explosion Effects and Properties Part I – Explosion Effects in Air*. Silver Spring, MD: White Oak Laboratory, Naval Surface Weapons Center.

U.S. Department of the Navy. (1999). *Environmental Effects of RF Chaff: A Select Panel Report to the Undersecretary of Defense for Environmental Security*. Washington, DC: U.S. Department of the Navy, Naval Research Laboratory.

U.S. Department of the Navy. (2009). *Environmental Assessment for Construction & Operation of Electromagnetic Railgun Research, Development, Test, and Evaluation Facility MILCON P-306*. Dahlgren, VA: Naval Surface Warfare Center, Dahlgren Laboratory.

U.S. Department of the Navy. (2017). *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)*. San Diego, CA: Space and Naval Warfare System Command, Pacific.

U.S. Environmental Protection Agency. (1999). *Understanding Oil Spills and Oil Spill Response*.

U.S. Fish and Wildlife Service. (1993). *Caribbean Roseate Tern Recovery Plan*. Atlanta, GA: U.S. Fish and Wildlife Service. Retrieved from http://www.fws.gov/ecos/ajax/docs/recovery_plan/830924.pdf.

U.S. Fish and Wildlife Service. (1996). *Piping Plover (Charadrius melodus) Atlantic Coast Population Revised Recovery Plan*. Hadley, MA.

U.S. Fish and Wildlife Service. (1998). *Roseate Tern (Sterna dougallii) Northeastern Population Recovery Plan*. Hadley, MA. Retrieved from http://ecos.fws.gov/docs/recovery_plan/981105.pdf.

U.S. Fish and Wildlife Service. (2005). *Regional Seabird Conservation Plan, Pacific Region*. Portland, OR: U.S. Fish and Wildlife Service, Migratory Birds and Habitat Programs, Pacific Region.

U.S. Fish and Wildlife Service. (2007). *Indiana Bat (Myotis sodalis) Draft Recovery Plan: First Revision*. Fort Snelling, MN: U.S. Department of the Interior, U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service. (2008a). *Final Biological Opinion, Cape Wind Associates, LLC, Wind Energy Project, Nantucket Sound, Massachusetts Formal Consultation # 08-F-0323*. Concord, NH: U.S. Department of the Interior.

U.S. Fish and Wildlife Service. (2008b). *Birds of Conservation Concern 2008*. Arlington, VA: U.S. Department of the Interior, Fish and Wildlife Service, Division of Migratory Bird Management.

U.S. Fish and Wildlife Service. (2009a). *Indiana Bat (Myotis sodalis) 5-Year Review: Summary and Evaluation*. Bloomington, IN: Bloomington Ecological Services Field Office.

U.S. Fish and Wildlife Service. (2009b). *Piping Plover (Charadrius melodus) 5-Year Review: Summary and Evaluation*. Hadley, MA: U.S. Fish and Wildlife Service. Retrieved from http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B079.

U.S. Fish and Wildlife Service. (2009c). *Abundance and Productivity Estimates Atlantic Coast Piping Plover Population, 1986–2009*. Washington, DC: U.S. Fish and Wildlife Service. Retrieved from http://www.fws.gov/northeast/pipingplover/pdf/abundance.pdf.

U.S. Fish and Wildlife Service. (2010a). *Caribbean Roseate Tern and North Atlantic Roseate Tern (Sterna dougallii dougallii) 5-Year Review: Summary and Evaluation*. Atlanta, GA: U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service. (2010b). *Red Knot (Calidris canutus rufa) Spotlight Species Action Plan*. Pleasantville, NJ: U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service. (2010c). *Species Profile: Roseate Tern (Sterna dougallii dougallii)*: U.S. Fish and Wildlife Service. Retrieved from http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B07O.

U.S. Fish and Wildlife Service. (2010d). *Endangered Species Program: Species Information*. Retrieved from http://www.fws.gov/endangered/wildlife.html.

U.S. Fish and Wildlife Service. (2013a). *Endangered and Threatened Wildlife and Plants; Endangered Species Status for the Florida Bonneted Bat*. Washington, DC: U.S. Department of the Interior, U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service. (2013b). *General Provisions; Revised List of Migratory Birds*. (50 CFR Parts 10 and 21). Washington, DC: U.S. Department of the Interior, U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service. (2013c). *Cahow or Bermuda Petrel (Pterodroma cahow) 5-Year Review: Summary and Evaluation*. Raleigh, NC: U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service. (2015a). *Information for Planning and Conservation lists of threatened and endangered species for the Study Area*. Retrieved from https://ecos.fws.gov/ipac/.

U.S. Fish and Wildlife Service. (2015b). *2015 Population Estimates for the Indiana Bat (Myotis sodalis) by U.S. Fish and Wildlife Service Region*. Washington, DC: U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service. (2016a). *Endangered and Threatened Wildlife and Plants; 4(d) Rule for the Northern Long-Eared Bat*. Washington, DC: U.S. Department of the Interior, U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service. (2016b). *Endangered and Threatened Wildlife and Plants; Determination That Designation of Critical Habitat Is Not Prudent for the Northern Long-Eared Bat*. Washington, DC: U.S. Department of the Interior, U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service. (2016c). *Programmatic Biological Opinion on Final 4(d) Rule for the Northern Long-Eared Bat and Activities Excepted from Take Prohibitions*. Bloomington, MN: U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service. (2017a). *Environmental Conservation Online System Species Profile for Northern long-eared Bat (Myotis septentrionalis)*. Retrieved from https://ecos.fws.gov/ecp0/profile/speciesProfile.action?spcode=A0JE.

U.S. Fish and Wildlife Service. (2017b). *Northern Long-Eared Bat Final 4(d) Rule White-Nose Syndrome Zone Around WNS/Pd Positive Counties/Districts*.

U.S. Geological Survey. (2006). *Migration of Birds: Routes of Migration*. *Northern Prairie Wildlife Research Center.* Retrieved from http://www.npwrc.usgs.gov/resource/birds/migratio/routes.htm.

U.S. Geological Survey. (2007). *Data from the 2006 International Piping Plover Census*. Corvallis, OR: Corvallis Work Group. Retrieved from http://pubs.usgs.gov/ds/426/.

U.S. Geological Survey (Cartographer). (2018). White-nose Syndrome Occurrence by County or District (or portions thereof). Retrieved from https://www.whitenosesyndrome.org/resources/map.

Ulanovsky, N., M. B. Fenton, A. Tsoar, and C. Korine. (2004). Dynamics of jamming avoidance in echolocating bats. *Proceedings of the Royal Society of London B: Biological Sciences, 271*(1547), 1467–1475.

Ulanovsky, N., and C. F. Moss. (2008). What the bat's voice tells the bat's brain. *Proceedings of the National Academy of Sciences, 105*(25), 8491–8498.

Ulanovsky, N., and C. F. Moss. (2011). Dynamics of hippocampal spatial representation in echolocating bats. *Hippocampus, 21*(2), 150–161.

Vandenbosch, R. (2000). Effects of ENSO and PDO events on seabird populations as revealed by Christmas bird count data. *Waterbirds, 23*(3), 416–422.

Votier, S. C., K. Archibald, G. Morgan, and L. Morgan. (2011). The use of plastic debris as nesting material by a colonial seabird and associated entanglement mortality. *Marine Pollution Bulletin, 62*(1), 168–172.

Wang, Y., Y. Pan, S. Parsons, M. Walker, and S. Zhang. (2007). Bats respond to polarity of a magnetic field. *Proceedings of the Royal Society of London B: Biological Sciences, 274*(1627), 2901–2905.

Warnecke, M., C. Chiu, J. Engelberg, and C. F. Moss. (2015). Active listening in a bat cocktail party: adaptive echolocation and flight behaviors of big brown bats, *Eptesicus fuscus*, foraging in a cluttered acoustic environment. *Brain, behavior and evolution, 86*(1), 6–16.

Washburn, B. E., P. J. Cisar, and T. L. Devault. (2014). Wildlife strikes with military rotary-wing aircraft during flight operations within the United States. *Wildlife Society Bulletin, 38*(2), 311–320.

Watts, B. D., G. D. Therres, and M. A. Byrd. (2007). Status, distribution, and the future of bald eagles in the Chesapeake Bay area. *Waterbirds, 30*, 25–38.

Waugh, S. M., D. P. Filippi, D. S. Kirby, E. Abraham, and N. Walker. (2012). Ecological Risk Assessment for seabird interactions in Western and Central Pacific longline fisheries. *Marine Policy, 36*(4), 933–946.

Weimerskirch, H. (2004). Diseases threaten Southern Ocean albatrosses. *Polar Biology, 27*, 374–379.

Wever, E. G., P. N. Herman, J. A. Simmons, and D. R. Hertzler. (1969). Hearing in the blackfooted penguin (*Spheniscus demersus*), as represented by the cochlear potentials. *Proceedings of the National Academy of Sciences, 63*, 676–680.

Wheeler, A. R., K. A. Fulton, J. E. Gaudette, R. A. Simmons, I. Matsuo, and J. A. Simmons. (2016). Echolocating big brown bats, *Eptesicus fuscus,* modulate pulse intervals to overcome range ambiguity in cluttered surroundings. *Frontiers in Behavioral Neuroscience, 10*, 125.

White, A. W. (2004). Seabirds in the Bahamian Archipelago and adjacent waters: Transient, wintering, and rare nesting species. *North American Birds, 57*, 436–451.

Wilcox, C., E. Van Sebille, and B. Hardesty. (2015). Threat of plastic pollution to seabirds is global, pervasive, and increasing. *PNAS, 112*(38), 11899–11904.

Wilcox, C., N. J. Mallos, G. H. Leonard, A. Rodriguez, and B. D. Hardesty. (2016). Using expert elicitation to estimate the impacts of plastic pollution on marine wildlife. *Marine Policy, 65*, 107–114.

William, T. C., and J. M. Williams. (1970). Radio tracking of homing and feeding flights of a neotropical bat, *Phyllostomus hastatus*. *Animal Behaviour, 18*, 302–309.

Williams, K. A., I. J. Stenhouse, E. E. Connelly, and S. M. Johnson. (2015). *Mid-Atlantic Wildlife Studies: Distribution and Abundance of Wildlife along the Eastern Seaboard 2012–2014* (Science Communications Series BRI 2015-19). Portland, ME: Biodiversity Research Institute.

Williams, T. C., J. M. Williams, and D. R. Griffin. (1966). The homing ability of the neotropical bat *Phyllostomus Hastatus*, with evidence for visual orientation. *Animal Behaviour, 14*(4), 468–473.

Wiltschko, R., S. Denzau, D. Gehring, P. Thalau, and W. Wiltschko. (2011). Magnetic orientation of migratory robins, *Erithacus rubecula*, under long-wavelength light. *The Journal of Experimental Biology, 214*(18), 3096–3101.

Wiltschko, W., and R. Wiltschko. (2005). Magnetic orientation and magnetoreception in birds and other animals. *Journal of Comparative Physiology A 191*(8), 675–693.

Winter, L., and G. E. Wallace. (2006). *Impacts of Feral and Free-Ranging Cats on Bird Species of Conservation Concern: A Five State Review of New York, New Jersey, Florida, California, and Hawaii*. American Bird Conservancy.

Wright, D. G. (1982). *A Discussion Paper on the Effects of Explosives on Fish and Marine Mammals in the Waters of the Northwest Territories* (Canadian Technical Report of Fisheries and Aquatic Sciences). Winnipeg, Canada: Western Region Department of Fisheries and Oceans.

Wurster, C. F., Jr., and D. B. Wingate. (1968). DDT residues and declining reproduction in the Bermuda petrel. *Science, 159*(3818), 979–981.

Yamashita, R., H. Takada, M. A. Fukuwaka, and Y. Watanuki. (2011). Physical and chemical effects of ingested plastic debris on short-tailed shearwaters, *Puffinus tenuirostris*, in the north Pacific Ocean. *Marine Pollution Bulletin, 62*(12), 2845–2849.

Yates, D. (2015). *Bat Mist Net Surveys at Maine Naval Installations: Cutler, Great Pond and Redington*. Portland, ME: Biodiversity Research Institute.

Yelverton, J. T., and D. R. Richmond. (1981). *Underwater Explosion Damage Risk Criteria for Fish, Birds, and Mammals.* Paper presented at the 102nd Meeting of the Acoustical Society of America. Miami Beach, FL.

Zakrajsek, E. J., and J. A. Bissonette. (2005). Ranking the risk of wildlife species hazardous to military aircraft. *Wildlife Society Bulletin, 33*(1), 258–264.

Zydelis, R., C. Small, and G. French. (2013). The incidental catch of seabirds in gillnet fisheries: A global review. *Biological Conservation, 162*, 76–88.

This page intentionally left blank.

Final
Environmental Impact Statement/Overseas Environmental Impact Statement
Atlantic Fleet Training and Testing

TABLE OF CONTENTS

List of Figures

List of Tables

3.10 Cultural Resources

CULTURAL RESOURCES SYNOPSIS

The United States Department of the Navy considered all potential stressors that cultural resources could potentially be exposed to from the Proposed Action. The following conclusions have been reached for the Preferred Alternative (Alternative 1):

- Explosive: Explosive stressors resulting from underwater explosions creating shock waves and cratering of the seafloor would not result in adverse effects to known submerged cultural resources. Therefore, no submerged cultural resources are expected to be affected.
- Physical Disturbance and Strike: Physical disturbance and strike stressors resulting from in-water devices, military expended materials, seafloor devices, pile driving, and vibration from sonic booms during training and testing activities would not result in adverse effects to known or unknown submerged cultural resources. Therefore, no submerged cultural resources are expected to be affected.

3.10.1 Introduction and Methods

3.10.1.1 Introduction

Submerged cultural resources are found throughout the Atlantic Fleet Training and Testing (AFTT) Study Area. The approach for the assessment of submerged cultural resources includes defining the resource; presenting the regulatory requirements for the identification, evaluation, and treatment within established jurisdictional parameters; establishing the specific resources subtypes in the Study Area; identifying the data used to define the current conditions; and providing the method for impact analysis.

Cultural resources are defined as districts, landscapes, sites, structures, objects, and ethnographic resources, as well as other physical evidence of human activities that are considered important to a culture, subculture, or community for scientific, traditional, religious, or other reasons. Cultural resources include archaeological resources, architectural resources, and traditional cultural properties related to pre-contact (prior to European contact) and post-contact periods.

Archaeological resources include prehistoric and historic sites and artifacts. Archaeological resources can have a surface component, a subsurface component, or both. Prehistoric resources are physical properties resulting from human activities that predate written records and can include village sites, temporary camps, lithic scatters, roasting pits, hearths, milling features, petroglyphs, rock features, shell mounds, and burials. Historic resources postdate the advent of written records in a region and include building foundations, refuse scatters, wells, cisterns, and privies. Submerged cultural resources include historical shipwrecks and other submerged historical materials, such as sunken airplanes and prehistoric cultural remains. Architectural resources are elements of the built environment consisting of standing buildings or structures from the historic period. These resources include existing buildings, dams, bridges, lighthouses, and forts. Traditional cultural properties are resources associated with beliefs and cultural practices of a living culture, subculture, or community. These beliefs and practices must be rooted in the group's history and must be important in maintaining the cultural identity of the group. Prehistoric archaeological sites and artifacts, historic and contemporary locations of traditional events, sacred places, landscapes, and resource collection areas, including fishing, hunting, or gathering areas, may be traditional cultural resources.

3.10.1.2 Identification, Evaluation, and Treatment of Cultural Resources

Procedures for identifying, evaluating, and treating cultural resources within state territorial waters (within 3 nautical miles [NM] of the coast) and United States (U.S.) territorial waters (within 12 NM of the coast) are contained in a series of federal and state laws and regulations, and agency guidelines. Archaeological, architectural, and cultural (including Native American and Native Hawaiian) resources are protected by a variety of laws and their implementing regulations: the National Historic Preservation Act of 1966 as amended in 2006, the Archeological and Historic Preservation Act of 1974, the Archaeological Resources Protection Act of 1979, the American Indian Religious Freedom Act of 1978, the Native American Graves Protection and Repatriation Act of 1990, the Submerged Lands Act of 1953, the Abandoned Shipwreck Act of 1987, and the Sunken Military Craft Act of 2004. The Advisory Council on Historic Preservation further guides treatment of archaeological and architectural resources through the regulations, Protection of Historic Properties (36 Code of Federal Regulations [CFR] part 800). The category of “historic properties” is a subset of cultural resources that is defined in the National Historic Preservation Act (54 United States Code [U.S.C.] section 300308) as any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places (National Register), including artifacts, records, and material remains related to such a property or resource.

Section 106 of the National Historic Preservation Act currently codified in 54 U.S.C. 306108 requires federal agencies to consider the effects of their actions on cultural resources listed in or eligible for inclusion in the National Register of Historic Places. The regulations implementing Section 106 (36 CFR part 800) specify a consultation process to assist in satisfying this requirement including efforts in identification of historic places. Consultation with the appropriate State Historic Preservation Offices, the Advisory Council on Historic Preservation, Native American tribes and Native Hawaiian organizations, the public, and state and federal agencies is required by Section 106 of the National Historic Preservation Act. Scoping letters for this Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) were sent to appropriate State Historic Preservation Offices and appropriate federally recognized Native American tribes (refer to Chapter 8, Public Involvement) on November 12, 2015.

Additional regulations and guidelines for submerged historical resources include 10 U.S.C. section 113, Title XIV for the Sunken Military Craft Act; the Abandoned Shipwreck Guidelines prepared by the National Park Service (National Park Service, 2007); and, for the purposes of conducting research or recovering U.S. Department of the Navy (Navy) ship and aircraft wrecks, the Guidelines for Archaeological Research Permit Applications on Ship and Aircraft Wrecks under the Jurisdiction of the Department of the Navy (32 CFR part 767) overseen by the Naval History and Heritage Command. The Sunken Military Craft Act does not apply to actions taken by, or at the direction of, the United States. In accordance with the Abandoned Shipwreck Act, abandoned shipwrecks in state waters are considered the property of the U.S. government; however, the federal government may transfer titles to abandoned shipwrecks to a state where shipwrecks fall within the jurisdiction of the state (Barnette, 2010). Warships or other vessels used for military purposes at the time of their sinking retain sovereign immunity (e.g., German U-boats). According to the principle of sovereign immunity, foreign warships sunk in U.S. territorial waters are protected by the U.S. government, which acts as custodian of the sites in the best interest of the sovereign nation (Neyland, 2001). In addition, the National Park Service Archeology Program, developed as a result of a presidential order, includes a collection of historical and archaeological resource protection laws to which federal managers adhere.

The addendum to the National Historic Preservation Act (54 U.S.C. section 307101(e)) requires an assessment by federal agencies of project effects to resources located outside U.S. territorial waters that are identified on the World Heritage List or on the applicable country's equivalent of the National Register of Historic Places. Eight resources listed on the World Heritage List and four resources listed on Canada's Historic Places Register are located adjacent to but not within the AFTT Study Area. No resources listed on the World Heritage List or on Canada's Historic Places Register occur in the AFTT Study Area.

No specific procedures for the identification and protection of cultural resources within the open ocean have been defined by the international community (Zander & Varmer, 1996). No treaty offering comprehensive protection of submerged cultural resources has been developed and implemented. However, a few international conventions prepared by the United Nations Educational, Scientific, and Cultural Organizations are applicable to submerged cultural resources, including the 1970 Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property; the 1972 Convention Concerning the Protection of the World Cultural and Natural Heritage; the 1982 Convention on the Law of the Sea; and the 2001 Convention on the Protection of the Underwater Cultural Heritage. Only the 1970 and 1972 conventions have been fully ratified by the United States. Individual submerged resources may be protected by international agreements, such as the RMS Titanic Maritime Memorial Act of 1986. The RMS Titanic Maritime Memorial Act of 1986 established the RMS Titanic as an international maritime memorial and gravesite.

3.10.1.3 Methods

3.10.1.3.1 Approach

The approach for establishing current conditions is based on different regulatory parameters defined by geographical location. Within U.S. territorial waters (within 12 NM of the coast), the National Environmental Policy Act (NEPA) is the guiding mandate. Areas beyond 12 NM in the open ocean will not be analyzed because obtaining data beyond 12 NM and at relatively great depths are not practicable, they are not associated with any state, and there are no State Historic Preservation Office consultation requirements beyond 3 NM in some cases and beyond 9 NM for some Gulf coast states and the territory of Puerto Rico. As such, impacts on potential cultural resources in the open ocean are discussed as a programmatic analysis in terms of the potential impact a stressor could have on a historic property within the Study Area beyond 12 NM.

The implementing regulations of Section 106 of the National Historic Preservation Act require federal agencies to take into account the effects that a proposed action would have on cultural resources included in or eligible for inclusion in the National Register of Historic Places. "Historic properties" is synonymous with National Register-eligible or -listed archaeological, architectural, or traditional resources. Cultural resources that have not been formally evaluated (i.e., have not had a Consensus Determination in consultation with the State Historic Preservation Office) may be considered potentially eligible, and thus are afforded the same regulatory consideration as resources listed in the National Register. Evaluations and determinations of historic properties within the Study Area are the responsibility of the federal agency, in consultation with the appropriate State Historic Preservation Office.

Properties are evaluated for nomination to the National Register and for National Register eligibility using the following criteria (36 CFR section 60.4(a)–(d)):

- Criterion A: Be associated with events that have made a significant contribution to the broad patterns of American history
- Criterion B: Be associated with the lives of persons significant in the American past
- Criterion C: Embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction
- Criterion D: Yield, or may be likely to yield, information important in prehistory or history

A historic property also must possess the following aspects of integrity: location, design, setting, materials, workmanship, feeling, and association to convey its significance and to qualify for the National Register. These seven aspects, in various combinations, define integrity. To retain integrity, a property will always possess several, and usually most, of these aspects.

Cultural resources in U.S. territorial waters (within 12 NM of the coast) are as follows:

- Resources listed in or eligible for listing in the National Register of Historic Places (Section 106 of the National Historic Preservation Act)
- Resources entitled to sovereign immunity (e.g., German U-boats)

3.10.1.3.2 Data Sources

Cultural resources information relevant to this EIS/OEIS was derived from a variety of sources, including previous environmental documents, previous technical memoranda on submerged cultural resource predictive models (Krivor, 2009; Southeastern Archaeological Research, 2009a, 2009b, 2009c), national and international shipwreck databases, the National Register Information System (managed by the National Park Service), information repositories associated with State Historic Preservation Offices, online maps and data, and published sources, as cited.

National and international shipwreck databases researched included the National Oceanic and Atmospheric Administration Advanced Wreck and Obstruction Information System, National Oceanic and Atmospheric Administration Aids to Navigation, the United States Coast Guard Hazards to Navigation, the General Dynamics Global Maritime Wrecks Database, the Northern Shipwrecks Database, accessible state archaeological master site files (Alabama, Florida, Georgia, Mississippi, North Carolina, and Virginia), and secondary sources of historic (older than 50 years) shipwreck information such as the Lytle-Holdcamper List, Shipwrecks in the Americas, and the Encyclopedia of American Shipwrecks (Burns, 2011). Many of the shipwreck databases and secondary sources overlap, generating data repetition. Many federal agencies "share" data as well as secondary sources. The intent of this analysis is not to provide a definitive number of shipwrecks, obstructions, or hazards within a defined area, but rather to provide an overview of potential resources within an area.

The online National Register Information System was reviewed to identify National Register of Historic Places-listed resources, historic districts, and National Historic Landmarks. Appropriate information repositories associated with the State Historic Preservation Offices were contacted and online databases reviewed for information on the location of submerged resources, type, and eligibility for listing on the state registers and National Register of Historic Places.

3.10.1.3.3 Cultural Context

Several types of cultural resources are associated with the Study Area: submerged prehistoric sites along the continental shelf, submerged historic resources and manmade obstructions, and historic architectural resources (e.g., Fort Jefferson in the Dry Tortugas). No Native American traditional use areas (e.g., fishing grounds) have been identified in the Study Area. The context within which these types of resources were formed provides an understanding of the overall development of the resource base and information on relative locations.

About 20,000 years ago, at the height of the last major glaciation (the Late Wisconsinan), sea level was as much as 328–393 feet (ft.) lower than present. Throughout the Holocene (since about 10,000 years ago), sea level has undergone a net rise, the rate of which has varied from as much as 0.39 inch per year to as little as 0.04 inch per year. The Holocene transgression has resulted in the landward migration of coastal habitats across the shelf and, in some cases, submergence and preservation of geomorphic features and landforms. Relative sea level varied considerably along the Atlantic and Gulf coasts. In the Northeast, paleo-landscapes were depressed by glacial isostatic pressure; in the Gulf of Mexico, paleo-landscapes were depressed by tectonic processes and sediment loading associated with the abandoned lobes of the Mississippi River delta.

The lower sea level during and following the Wisconsinan glaciation is an important factor for determining the potential for prehistoric sites on drowned continental shelf surfaces. Development of vegetation and adaptation of natural resources would have made the exposed continental shelf attractive to human populations. Those paleo-environmental conditions provide the basis for theories concerning prehistoric subsistence and settlement patterns that are extrapolated for the continental shelf.

The potential for prehistoric and historic archaeological sites has been the subject of hypothesis and a number of detailed studies (Bourque, 1979; Coastal Environments Inc., 1977; Garrison et al., 1989; Pearson et al., 2003; Science Applications International Corporation, 1981). These studies were commissioned to establish baselines for submerged cultural resource management policy by agencies responsible for those resources (Research Planning Inc. et al., 2004). The North Atlantic cultural resources baseline study covered the continental shelf between Cape Hatteras, North Carolina and the Bay of Fundy just over the U.S. border in Canada. The report identified high-probability areas for both prehistoric and submerged historic resources (Bourque, 1979). The South Atlantic cultural resources baseline study covered the continental shelf between Cape Hatteras, North Carolina and Key West, Florida. The research and predictive models for South Atlantic submerged cultural resources were published in 1979 (Science Applications International Corporation, 1981). The Gulf of Mexico cultural resources baseline study was carried out for the National Park Service and published in 1977. One of the most important management tools produced by this study was identification of high-probability areas for both submerged prehistoric and historic resources (Coastal Environments Inc., 1977).

Submerged prehistoric archaeological sites most likely represent Paleoindian (late Pleistocene) and Early Archaic to Middle Archaic (early Holocene) occupations on the continental shelves, when the post-glacial sea level rise inundated low-lying areas (Faught, 2004) (Figure 3.10-1). Submerged prehistoric sites are most likely associated with relic landforms such as relic rivers and stream channels; relic estuary complexes; and relic berms, dunes, and hummocks. Paleoindian and Early Archaic site types include base camps, outlying hunting stations, quarries, and reduction stations. Site resources of this time period typically consist of low-density lithic scatters and hearths.

Source: Florida Division of Historical Resources (2011)

Figure 3.10-1: Artifacts from a Submerged Prehistoric Resource

The Atlantic and the Gulf of Mexico continental shelves have become repositories for the remains of the entire spectrum of vessels that supported development of the Western Hemisphere from the early 16th century to modern day. While the distribution of shipwreck sites on the continental shelf cannot be associated specifically with the submerged ridge and swale features that currently represent major sources of sand, those deposits lie amid the historic routes of navigation. Although shipwrecks are somewhat random in their areal distribution, it is generally accepted that higher densities exist in association with established navigation routes, with environmental obstructions to navigation, and by inshore areas (Research Planning Inc. et al., 2004).

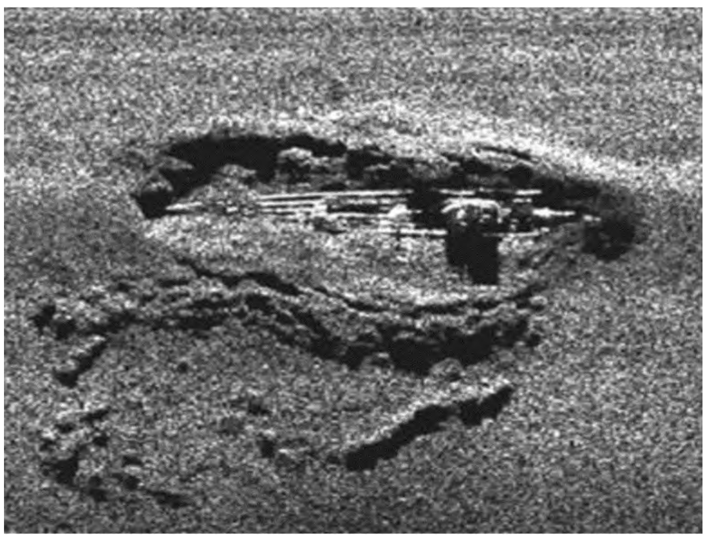
Historic shipwrecks (example provided in Figure 3.10-2 and Figure 3.10-3), classified as archaeological resources, are numerous in the Study Area (53,436 known wrecks, obstructions, occurrences, or “unknowns”) (Burns, 2011). As the result of mechanical, chemical, and biological erosion and decay, shipwrecks exhibit differential preservation. Shipwrecks in high-energy zones, such as in shallow waters along the coastlines, are generally less well preserved because they have been scoured by the abundant fluvial sediments driven by coastal currents and heavy wave action (Pearson et al., 2003). However, if portions of the shipwreck are buried in sediment and protected from scouring, preservation may be high. Ferrous metal oxidation is accelerated by elevated seawater temperature, and shipworms consume wooden ship members. Deep-water wrecks may be better preserved because the lower seawater temperatures at depth slow the oxidation of ferrous metals and reduce the number of wood eating shipworms; however, preservation of deep-water shipwrecks does vary (Pearson et al., 2003).

In accordance with the Abandoned Shipwreck Act, abandoned shipwrecks in state waters on the Atlantic coast and in the Gulf of Mexico are considered the property of the U.S. government (Barnette, 2010). According to the principle of sovereign immunity, foreign warships sunk in U.S. territorial waters are protected by the U.S. government, which acts as custodian of the sites in the best interest of the sovereign nation (Neyland, 2001).

Estimated numbers of identified historic submerged resources used in this EIS/OEIS are compiled from information obtained from various databases. Because no comprehensive survey or evaluation of submerged historic resources has occurred in the entire Study Area and because some areas (e.g., coastal zones and continental shelf) are considered high probability for historic shipwrecks, discoveries of additional historic shipwrecks may occur. Additionally, some existing and unrecorded historic shipwrecks could be considered eligible for the National Register of Historic Places.

Source: Florida Division of Historical Resources (2011)

Figure 3.10-2: Submerged Historic Resource (Spanish Galleon)



Source: Warren (2004)

Figure 3.10-3: High-Resolution Side-Scan Sonar Image of Submerged Historic Resource (World War II Vessel)

3.10.1.4 Methods for Impact Analysis

Impact analysis for cultural resources is based on different parameters defined by geographical location. Within U.S. territorial waters, Section 106 of the National Historic Preservation Act and NEPA evaluation are the guiding mandates. In general, impacts are assessed by the importance of the resource, the sensitivity of the resource to the proposed activities, and the duration of the effects on the environment.

3.10.2 Affected Environment

Seven large marine ecosystems are located entirely or partially within the Study Area: the West Greenland Shelf, Newfoundland-Labrador Shelf, Scotian Shelf, Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Caribbean Sea, and Gulf of Mexico. These ecosystems exhibit similar types of cultural resources in similar submerged settings.

3.10.2.1 Submerged Prehistoric Resources

Submerged prehistoric sites have been documented in shallow offshore areas in the Northeast U.S. Continental Shelf and the Gulf of Mexico Large Marine Ecosystems.

Submerged prehistoric sites have been identified offshore in southern New England (Merwin et al., 2003). Submerged prehistoric sites are most likely associated with relic landforms such as relic rivers and stream channels; relic estuary complexes; and relic berms, dunes, and hummocks (Research Planning Inc. et al., 2004), and may occur in the Northeast U.S. Continental Shelf Large Marine Ecosystem.

Geologic features in the eastern Gulf of Mexico (karst topography, relic barrier islands with back barrier bays and lagoons, and coastal dune lakes) are used as indicators of potential cultural resources and have a high probability of containing prehistoric sites. Sites in high-probability zones may date from the Paleoindian to the Archaic periods. Submerged prehistoric sites have been identified offshore in northwestern Florida (Faught, 2004). Submerged prehistoric archaeological sites have been identified out to a distance of 9 NM in Florida (Faught, 2010), but sites are predicted as far as 85 linear miles offshore at a depth of 130 ft., along the inundated Paleoindian or Clovis Shoreline (Faught, 2010).

3.10.2.2 Known Wrecks, Obstructions, Occurrences, or "Unknowns"

Freighters, tankers, ships-of-war, passenger ships, submarines, and fishing vessels have been sunk, lost, or run aground. Natural activities and features have played important roles in creating submerged cultural resources; those include powerful currents (e.g., the Labrador Current), winds (including cold fronts), rough seas (gales, hurricanes, blizzards), coastal topography (e.g., Cape Cod, Vineyard Sound, Cape Hatteras, Cape Fear), and shallow water and sandbars (Isles of Shoals, Nantucket Shoals, Diamond Shoals, Lookout Shoals, and Frying Pan Shoals). The Revolutionary War, the War of 1812, and the Civil War contributed to numerous ship losses from the northeast to the Gulf of Mexico. World Wars I and II used submarine warfare, which destroyed numerous cargo ships. Wrecks are concentrated in the Cape Hatteras area, where the intersection of cold northern currents and the northbound Gulf Stream forms shoals and submerged shifting sandbars that, in combination with powerful currents, treacherous seas, and wind, create hazards for mariners.

Review of all databases indicates the presence of 13,606 known wrecks, obstructions, occurrences, or sites marked as "unknown" in U.S. territorial waters in the seven large marine ecosystems, and 3,774 resources beyond U.S. territorial waters (outside 12 NM) (Figures 3.10-4, 3.10-5, and 3.10-6**)**. Most "unknown" obstructions tend to be modern debris but cannot be ruled out as potential cultural resources. Because no comprehensive survey or evaluation of submerged historic resources has occurred in the Study Area, additional shipwrecks may exist, and some existing and newly discovered shipwrecks could be considered eligible for the National Register of Historic Places. A predictive model was used to determine the probability of encountering additional shipwrecks in portions of the Study Area (Burns, 2011; Roberts, 2012). The predictive model is based on a point system, where the higher point assumes a higher probability for submerged cultural resources. This model assigns points to various factors, including ports/anchorages, obstructions/hazards, shipping routes, and known shipwreck locations; the model assumes there is a higher probability of vessel loss near a port/anchorage, near an obstruction/navigational hazard, or near a designated shipping route. This model also acknowledges that if other known shipwreck sites are nearby, the probability increases for additional sites within that area. Results of the predictive model indicate that the portions of the Study

Area (Exclusive Economic Zones of Bermuda, Canada, and Mexico) within the large marine ecosystems exhibit moderate to high potential to contain submerged cultural resources (Burns, 2011; Roberts, 2012).

3.10.2.2.1 Cultural Resources Eligible for or Listed in the National Register of Historic Places

There are three National Historic Landmarks or monuments and two National Register of Historic Places historic districts or Multiple Property Sites within the Study Area. In addition, there are 21 resources listed in the National Register of Historic Places, and 10 resources that are considered eligible for the National Register of Historic Places within the Study Area (Table 3.10-1).

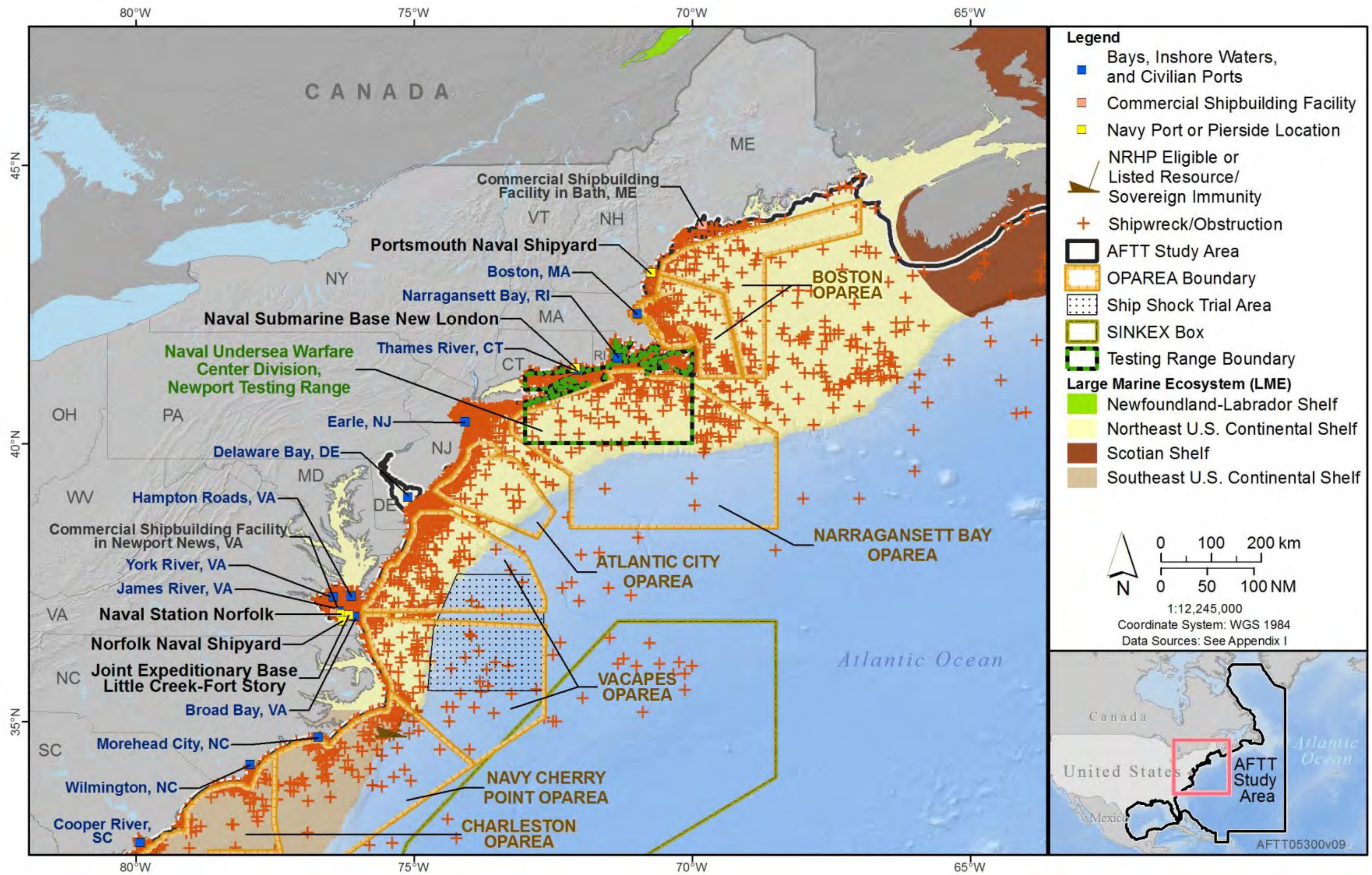
3.10.2.2.2 Resources with Sovereign Immunity

Sovereign immunity is an international law which preserves each nation's title in their governmental ships and property. German U-boats retain sovereign immunity and include the U-869 (Uboat.net, 2010c) and the U-853 (Uboat.net, 2010a) in the Northeast U.S. Continental Shelf Large Marine Ecosystem, U-352 (North Carolina Wreck Diving, 2008) in the Southeast U.S. Continental Shelf Large Marine Ecosystem, and U-166 (Warren, 2004) and U-157 (Uboat.net, 2010b) in the Gulf of Mexico Large Marine Ecosystem.

3.10.2.3 Tortugas Military Operations Area

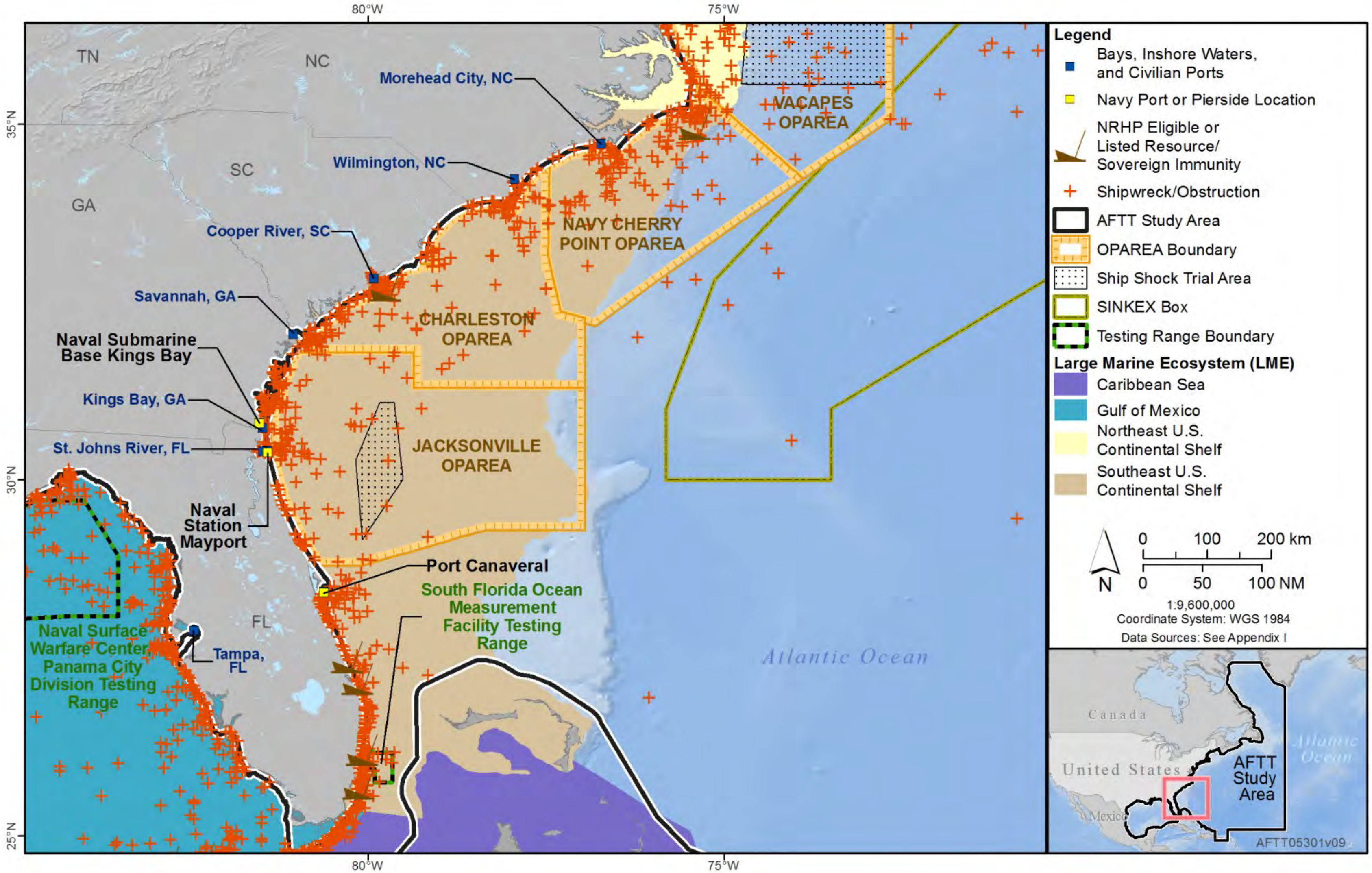
The Tortugas Military Operations Area is not a traditional military operating area but rather an air exclusion zone established to protect Fort Jefferson and Dry Tortugas National Park. Tactical maneuvers resulting in supersonic flight are not conducted in the Tortugas Military Operations Area above Fort Jefferson and Dry Tortugas National Park between 5,000 ft. and 18,000 ft. The Tortugas Military Operations Area is the airspace within an area bounded by a line 12 NM from and parallel to the shoreline of the Dry Tortugas Islands, creating a circular area (Federal Aviation Administration, 2009).

Previous research indicates that fragile mortar in the brick masonry at Fort Jefferson may be susceptible to damage from sonic booms (Hanson et al., 1991; James et al., 2009). No supersonic flight activity is authorized in the Tortugas Military Operations Area; therefore, no sonic booms are intentionally generated below 18,000 ft. and within 12 NM from the shoreline of all the islands encompassing Fort Jefferson. Sonic booms are occasionally generated by military aircraft and are logged by National Park Service staff at Fort Jefferson. Due to the increase in sonic booms logged at Fort Jefferson in 2008 and early 2009, the Navy took precautionary measures to minimize the number of sonic booms reaching Fort Jefferson. In April 2009, the Naval Air Station Key West Air Operations Department incorporated Tortugas Military Operations Area flight avoidance awareness briefings into pre-flight planning guidance provided to all aircrew. Increased awareness of the airspace restrictions helps minimize inadvertent supersonic flight in the vicinity of Dry Tortugas. Additionally, air combat maneuver engagement zones and basic fighter maneuvering areas have been modified in W-174 so that the resulting flight activities generate fewer sonic booms in the airspace adjacent to Fort Jefferson. Furthermore, training flights predisposed to supersonic conditions are segregated and only conducted in redesignated airspace at least 30 NM from Fort Jefferson. Avoidance and mitigation measures were enacted in May 2009. The Navy will continue to implement mitigation measures under the Proposed Action to help preserve the structural integrity of Fort Jefferson, as described in Section 5.3.2.5 (Aircraft Overflight Noise).



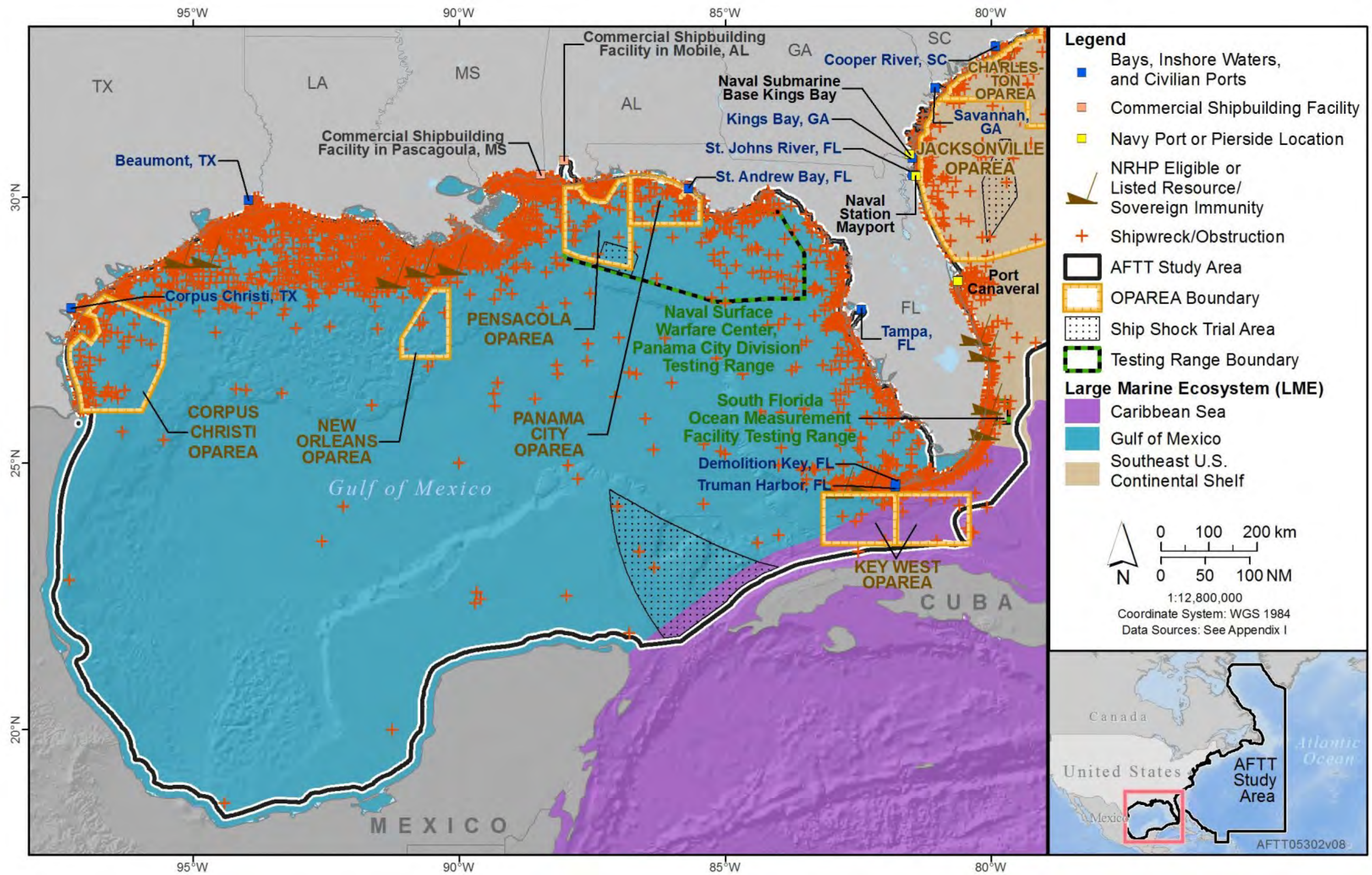
Notes: AFTT: Atlantic Fleet Training and Testing; NRHP: National Register of Historic Places; OPAREA: Operating Area; VACAPES: Virginia Capes

Figure 3.10-4: Known Shipwrecks, Obstructions, Occurrences, or Sites Marked as "Unknown" in the Northeast United States Continental Shelf Large Marine Ecosystem



Notes: AFTT: Atlantic Fleet Training and Testing; NRHP: National Register of Historic Places; OPAREA: Operating Area

Figure 3.10-5: Known Shipwrecks, Obstructions, Occurrences, or Sites Marked as "Unknown" in the Southeast United States Continental Shelf Large Marine Ecosystem



Notes: AFTT: Atlantic Fleet Training and Testing; NRHP: National Register of Historic Places; OPAREA: Operating Area

Figure 3.10-6: Known Shipwrecks, Obstructions, Occurrences, or Sites Marked as "Unknown" in the Southeast United States Continental Shelf, Caribbean Sea, and Gulf of Mexico Large Marine Ecosystems

Table 3.10-1: National Historic Landmarks, Monuments, and Cultural Resource Listed in the National Register of Historic Places

Resource	***Large Marine Ecosystem***	***Description***	***National Register of Historic Places***	***National Historic Landmark/ Monument***	***Reference***
HMS Orpheus	Northeast U.S. Continental Shelf	British vessel, 1773–1778	Listed	No	National Park Service (2010)
USS Cumberland	Northeast U.S. Continental Shelf (pierside)	Wooden frigate, 1842–1862	Listed	No	Judge (2007); National Park Service (2010); Virginia Department of Historic Resources (2010)
CSS Florida	Northeast U.S. Continental Shelf (pierside)	Three-masted, wooden-hulled vessel, 1864	Listed	No	Judge (2007); Virginia Department of Historic Resources (2010)
USS Monitor	Southeast U.S. Continental Shelf	Ironclad Civil War gunship, 1862	Listed	Yes	National Park Service (2008); National Register Information System (2008); Naval Historical Center (2008); Neyland (2001); USS Monitor Center (2008)
USS Huron	Southeast U.S. Continental Shelf	Iron vessel, 1875–1877	Listed	No	National Register Information System (2010); North Carolina Office of State Archaeology (2010)
Cape Fear Civil War Shipwrecks Discontiguous District	Southeast U.S. Continental Shelf	Civil War shipwrecks, 1861–1864 (16 blockade-running steamers, 4 Union vessels, and 1 Confederate vessel)	Historic District	No	Wilde-Ramsing and Angley (1985)
Barge Wreck	Southeast U.S. Continental Shelf	19th-century barge	Listed	No	
Paul Palmer	Northeast U.S. Continental Shelf	Five-masted schooner, 1913	Listed	No	Northern Atlantic Dive Expeditions (2018)
Joffre	Northeast U.S. Continental Shelf	Auxiliary fishing schooner and then converted into an eastern rig dragger, 1947	Listed	No	Gerry E. Studds Stellwagen Bank National Marine Sanctuary (2018)

Table 3.10-1: National Historic Landmarks, Monuments, and Cultural Resource Listed in the National Register of Historic Places (continued)

Resource	*Large Marine Ecosystem*	*Description*	*National Register of Historic Places*	*National Historic Landmark/ Monument*	*Reference*
Robert J. Walker	Northeast U.S. Continental Shelf	Side-wheel steamer served as a survey ship, 1860	Listed	No	Delgado (2013)
Empire Gem	Northeast U.S. Continental Shelf	Steel Tanker, 1942	Listed	No	National Oceanic and Atmospheric Administration and National Marine Sanctuaries (2017b)
Lancing	Northeast U.S. Continental Shelf	Steel Tanker, 1942	Listed	No	National Oceanic and Atmospheric Administration and National Marine Sanctuaries (2017a)
Roosevelt Inlet Shipwreck	Northeast U.S. Continental Shelf	Rigged commercial ship, 18th Century	Listed	No	Southeastern Archaeological Research (2010)
Cape Gull	Southeast U.S. Continental Shelf	United States Coast Guard cutter	Listed	No	Burns (2011)
1733 Spanish Plate Fleet Shipwrecks	Southeast U.S. Continental Shelf	Spanish Fleet, 1733 (*Angustias*, *Chavas*, *El Gallo Indiano*, *El Infante*, *El Rubi*, *Herrara*, *Populo*, *San Felipe*, *San Francisco*, *San Jose*, *San Pedro*, *Sueco de Arizon*, and *Tres Puentes*)	Multiple Property Site	No	McKinnon et al. (2006)
General C.B. Comstock	Southeast U.S. Continental Shelf	A U.S. hydraulic hopper dredge, 1913	Listed	No	National Register Information System (2016)
H.L. Hunley	Southeast U.S. Continental Shelf	Submarine, 1864	Listed	No	The Editors of Encyclopedia Britannica (2018)
SS Antonio Lopez	Caribbean	Spanish blockade runner, 1989	Listed	Yes	National Register Information System (2016)

Table 3.10-1: National Historic Landmarks, Monuments, and Cultural Resource Listed in the National Register of Historic Places (continued)

Resource	*Large Marine Ecosystem*	*Description*	*National Register of Historic Places*	*National Historic Landmark/ Monument*	*Reference*
Fort Jefferson	Gulf of Mexico	Third System seacoast fortification, 1846	Listed	Yes	Clark (2008); Morrison et al. (1974)
Henrietta Marie	Gulf of Mexico	English merchant/slave ship, 1700	Eligible	No	Mel Fisher Maritime Heritage Society (2001)
Vamar	Gulf of Mexico	Reinforced metal hulled vessel, 1919–1942	Listed	No	Burns (2011)
SS Tarpon	Gulf of Mexico	Cargo ship, 1896–1937	Listed	No	Florida Department of State (1997, 2007)
USS Massachusetts	Gulf of Mexico	Battleship, 1896–1921	Listed	No	Florida Department of State (2008)
USS Hatteras	Gulf of Mexico	Iron-hulled, side-wheel steamer, 1861–1863	Listed	No	Bureau of Ocean Energy Management and Regulation and Enforcement (2011)
R.M. Parker, Jr.	Gulf of Mexico	Tanker, 1919–1942	Eligible	No	Enright et al. (2006)
Castine	Gulf of Mexico	Steel-hulled gunboat, 1892–1924	Eligible	No	Enright et al. (2006)
Sheherazade	Gulf of Mexico	French tanker, 1935–1942	Eligible	No	Enright et al. (2006)
Boca Chica No.1	Gulf of Mexico	Wooden-hull sailing ship, 1800s	Eligible	No	Enright et al. (2006)
Boca Chica No.2	Gulf of Mexico	Unknown	Eligible	No	None
SS Nicaragua	Gulf of Mexico	Cargo steamer, 1912	Eligible	No	National Park Service (2015)
SS Mary	Gulf of Mexico	Sidewheeler, 1876	Eligible	No	Ford (2014)
Santa Maria De Yicar	Gulf of Mexico	Spanish cargo and passenger ship, 1554	Eligible	No	National Park Service (2017)
Espiritu Santo	Gulf of Mexico	Spanish cargo and passenger ship, 1554	Eligible	No	National Park Service (2017)

Note: U.S. = United States

3.10.3 Environmental Consequences

This section evaluates how and to what degree the activities described in Chapter 2 (Description of Proposed Action and Alternatives) could impact cultural resources within U.S. territorial waters and World Heritage sites located in the Study Area. Tables 2.6-1 through 2.6-4 present the proposed training and testing activities and locations for each alternative. Additional details of the proposed training and testing activities are provided in Appendix A (Navy Activity Descriptions). Appendix B (Activity Stressor Matrices) describes the warfare areas and associated stressors that were considered for analysis of cultural resources. The stressors vary in intensity, frequency, duration, and location within the Study Area. The stressors applicable to cultural resources in the Study Area that are analyzed include:

- **Explosives** (explosives – shock [pressure] waves from underwater explosions, explosives – cratering)
- **Physical Disturbance and Strikes** (in-water devices, military expended materials, seafloor devices, pile driving, and vibration from sonic booms)

The use of sonar does not affect the structural elements of historic shipwrecks. Archaeologists regularly use multi-beam sonar and side-scan sonar to explore shipwrecks without disturbing them. Based on the physics of underwater sound, the shipwreck would need to be very close (less than 22 ft.) to the sonar sound source for the shipwreck to experience any slight oscillations from the induced pressure waves. Any oscillations experienced at a depth of less than 22 ft. would be negligible up to within a few yards from the sonar source. This distance is smaller than the typical safe navigation and operating depth for most sonar sources, and is not expected to impact historic shipwrecks. Therefore, sonar is not considered a stressor that would result in an impact on cultural resources and will not be analyzed further in this document.

The analysis includes consideration of the mitigation that the Navy will implement to avoid potential impacts on cultural resources from explosives and physical disturbance and strike stressors. In the event that the Navy impacts a submerged historic or prehistoric resource, consultation would be conducted with the appropriate State Historic Preservation Officers in accordance with 36 CFR section 800.13(a)(3).

3.10.3.1 Explosive Stressors

Explosive stressors that could impact cultural resources are vibration, shock waves, and explosive cratering from underwater explosions. A shock wave and oscillating bubble pulses resulting from any kind of underwater explosion, such as explosive torpedoes, missiles, bombs, projectiles, mines, and explosive sonobuoys, could impact the exposed portions of submerged historic resources if such resources were located nearby. Shock waves (pressure) generated by underwater explosions would be periodic rather than continuous, and could create overall structural instability and eventual collapse of architectural features of submerged historic resources. The amount of damage would depend on factors such as the size of the charge, the distance from the historic shipwreck, the water depth, and the topography of the ocean floor.

In addition, impacts from aircraft noise (i.e., vibration from sonic booms) could create increased structural instability and damage to Fort Jefferson, a fragile historic architectural resource in the Gulf of Mexico Large Marine Ecosystem (Hanson et al., 1991; James et al., 2009).

3.10.3.1.1 Impacts of Explosives — Shock Waves from Underwater Explosions

Anti-surface missiles and projectiles explode at or immediately below the ocean surface (within the first meter of depth). Shock waves (pressure) from these types of explosions within the water column would not reach historic resources on the ocean floor. Underwater detonations of explosive sonobuoys would occur below the surface and detonate in the mid-water column. Shock waves from nearby underwater detonations may affect the exposed portions of historic shipwrecks if such resources were located in the area and near the depth of the explosive. Impacts on previously identified cultural resources from underwater explosions generating vibration and shock waves within the Study Area are not anticipated because (1) detonations at or near the surface from missiles and projectiles all occur in deep water, and the shock waves would not reach historic resources on the seafloor, and (2) detonations that occur in the mid-water column from explosive sonobuoys, which are much smaller explosive charges than missiles and projectiles, would also occur in deep water, well above the seafloor; so the shock waves would not reach historic resources on the seafloor, and (3) underwater detonations placed by Navy divers occur only in specially designated areas (see Section 2.3.3.9, Underwater Detonation Safety), far from any identified historic resources.

3.10.3.1.1.1 Impacts of Explosive Shock Waves from Underwater Explosions under Alternative 1

<u>Impacts of Explosive Shock Waves from Underwater Explosions under Alternative 1 for Training Activities</u>

Under Alternative 1, training activities (including the use of explosives) would continue within the Northeast U.S. Continental Shelf (Virginia Capes Range Complex), the Southeast U.S. Continental Shelf (Navy Cherry Point and Jacksonville Range Complexes), the Gulf of Mexico (Key West and Gulf of Mexico Range Complexes), and the Caribbean (Key West Range Complex) Large Marine Ecosystems. Because no comprehensive survey or evaluation of submerged historic resources has occurred in the Study Area, unrecorded historic resources could be disturbed by underwater detonations. However, because the Navy routinely avoids locations of known obstructions which include submerged historic resources, and because overall types and locations of training activities are not expected to change from those currently conducted by the Navy (refer to Table 3.0-27), no impacts on identified submerged historic resources located in the Study Area are expected from shock waves created by underwater explosives. As discussed in Section 5.4.1 (Mitigation Areas for Seafloor Resources), the Navy will implement mitigation to avoid impacts from explosives on seafloor resources in mitigation areas throughout the Study Area. For example, the Navy will not conduct explosive mine countermeasure and neutralization activities within a specified distance of shipwrecks and identified submerged historic properties.

<u>Impacts of Explosive Shock Waves from Underwater Explosions under Alternative 1 for Testing Activities</u>

Under Alternative 1, testing activities (including the use of explosives) would continue within the Northeast U.S. Continental Shelf Large Marine Ecosystem (Naval Undersea Warfare Center Division, Newport Testing Range; Virginia Capes Range Complex) and the Gulf of Mexico Large Marine Ecosystem (Naval Surface Warfare Center, Panama City Division Testing Range). Because no comprehensive survey or evaluation of submerged historic resources has occurred in the Study Area, unrecorded historic resources could be disturbed by underwater detonations. However, because the Navy routinely avoids locations of known obstructions which include submerged historic resources and overall types and locations of testing activities are not expected to change from those currently conducted by the Navy (refer to Table 3.0-28), no impacts on submerged historic resources located in the Study Area are expected from shock waves created by underwater explosives. As discussed in Section 5.4.1 (Mitigation Areas for Seafloor Resources), the Navy will implement mitigation to avoid impacts from explosives on seafloor resources in mitigation areas throughout the Study Area. For example, the Navy will not conduct explosive mine countermeasure and neutralization activities within a specified distance of shipwrecks.

3.10.3.1.1.2 Impacts of Explosive Shock Waves from Underwater Explosions under Alternative 2

Impacts of Explosive Shock Waves from Underwater Explosions under Alternative 2 for Training Activities

Under Alternative 2, training activities (including the use of explosives) would remain the same as those described under Alternative 1 and would continue to occur within the Northeast U.S. Continental Shelf (Virginia Capes Range Complex), the Southeast U.S. Continental Shelf (Navy Cherry Point and Jacksonville Range Complexes), the Gulf of Mexico (Key West and Gulf of Mexico Range Complexes), and the Caribbean (Key West Range Complex) Large Marine Ecosystems. Because no comprehensive survey or evaluation of submerged historic resources has occurred in the Study Area, unrecorded historic resources could be disturbed by underwater detonations. However, because the Navy routinely avoids locations of known obstructions which include submerged historic resources and overall types and locations of training activities are not expected to change from those currently conducted by the Navy (refer to Table 3.0-27), no impacts on submerged historic resources located in the Study Area are expected from shock waves created by underwater explosives. As discussed in Section 5.4.1 (Mitigation Areas for Seafloor Resources), the Navy will implement mitigation to avoid impacts from explosives on seafloor resources in mitigation areas throughout the Study Area. For example, the Navy will not conduct explosive mine countermeasure and neutralization activities within a specified distance of shipwrecks.

Impacts of Explosive Shock Waves from Underwater Explosions under Alternative 2 for Testing Activities

Under Alternative 2, testing activities (including the use of explosives) would remain the same as those described under Alternative 1 and would continue to occur within Northeast U.S. Continental Shelf Large Marine Ecosystem (Naval Undersea Warfare Center Division, Newport Testing Range; Virginia Capes Range Complex) and the Gulf of Mexico Large Marine Ecosystem (Naval Surface Warfare Center, Panama City Division Testing Range). Because no comprehensive survey or evaluation of submerged historic resources has occurred in the Study Area, unrecorded historic resources could be disturbed by underwater detonations. However, because the Navy routinely avoids locations of known obstructions which include submerged historic resources and overall types and locations of testing activities are not expected to change from those currently conducted by the Navy (refer to Table 3.0-28), no impacts on submerged historic resources located in the Study Area are expected from shock waves created by underwater explosives. As discussed in Section 5.4.1 (Mitigation Areas for Seafloor Resources), the Navy will implement mitigation to avoid impacts from explosives on seafloor resources in mitigation areas throughout the Study Area. For example, the Navy will not conduct explosive mine countermeasure and neutralization activities within a specified distance of shipwrecks.

3.10.3.1.1.3 Impacts of Explosive Shock Waves from Underwater Explosions under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various explosive stressors (e.g., explosive shockwaves) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.10.3.1.2 Impacts from Explosives – Cratering

Underwater explosions near or on the seafloor could create sediment displacement in the form of cratering and could affect submerged prehistoric sites and unrecorded historic resources at or near the explosive impact. Cratering of unconsolidated soft bottom habitats would result from charges set on or near the bottom. For a specific explosive charge size, crater depths and widths would vary depending on depth of the charge and sediment type. However, crater dimensions generally decrease as bottom depth increases.

As discussed in Section 2.3.3.9 (Underwater Detonation Safety), underwater detonation training takes place in specially designated areas, and bottom-placed explosives are laid by divers who are able to observe bottom conditions and avoid sensitive areas. In addition, all other explosives would detonate near the surface and would occur in deep water.

3.10.3.1.2.1 Impacts from Explosives – Cratering under Alternative 1

Impacts from Explosives – Cratering under Alternative 1 for Training Activities

Under Alternative 1, mine warfare activities would occur within the Northeast U.S. Continental Shelf (Virginia Capes Range Complex), the Southeast U.S. Continental Shelf (Navy Cherry Point and Jacksonville Range Complexes), the Caribbean Sea (Key West Range Complex), the Gulf of Mexico (Key West and Gulf of Mexico Range Complexes), and the Caribbean (Key West Range Complex) Large Marine Ecosystems. Cratering created by deep underwater explosions is not expected to disturb or damage artifacts on the seafloor and archaeological deposits buried in the ocean sediments in the Study Area because bottom-placed explosives are laid by divers who are able to observe bottom conditions and avoid sensitive areas and all other explosives would detonate near the surface in deep water. Because standard operating procedures (refer to Section 2.3.3.9, Underwater Detonation Safety) are implemented to protect submerged cultural resources, and overall types and locations of training activities are not expected to change from those currently conducted by the Navy (refer to Table 3.0-27), no impacts on submerged historic resources located in the Study Area are expected from cratering by underwater explosions. As discussed in Section 5.4.1 (Mitigation Areas for Seafloor Resources), the Navy will implement mitigation to avoid impacts from explosives on seafloor resources in mitigation areas throughout the Study Area. For example, the Navy will not conduct explosive mine countermeasure and neutralization activities within a specified distance of shipwrecks.

Impacts from Explosives – Cratering under Alternative 1 for Testing Activities

Under Alternative 1, testing activities would occur within the Northeast U.S. Continental Shelf (Virginia Capes Range Complex) and the Gulf of Mexico (Naval Surface Warfare Center, Panama City Division Testing Range and Gulf of Mexico Range Complex) Large Marine Ecosystems. Cratering created by deep underwater explosions is not expected to disturb or damage artifacts on the seafloor and archaeological deposits buried in the ocean sediments in the Study Area because bottom-placed explosives are laid by divers who are able to observe bottom conditions and avoid sensitive areas and all other explosives would detonate near the surface in deep water. Because standard operating procedures are implemented to protect submerged cultural resources, and overall types and locations of testing activities are not expected to change from those currently conducted by the Navy (refer to Table 3.0-28), no impacts on submerged historic resources located in the Study Area are expected from cratering by underwater explosions. As discussed in Section 5.4.1 (Mitigation Areas for Seafloor Resources), the Navy will implement mitigation to avoid impacts from explosives on seafloor resources in mitigation areas throughout the Study Area. For example, the Navy will not conduct explosive mine countermeasure and neutralization activities within a specified distance of shipwrecks.

3.10.3.1.2.2 Impacts from Explosives – Cratering under Alternative 2

Impacts from Explosives – Cratering under Alternative 2 for Training Activities

Under Alternative 2, the number of explosive rounds and locations associated with training activities are the same as under Alternative 1 and would occur within the Northeast U.S. Continental Shelf (Virginia Capes Range Complex), the Southeast U.S. Continental Shelf (Navy Cherry Point and Jacksonville Range Complexes), the Gulf of Mexico (Key West and Gulf of Mexico Range Complexes), and the Caribbean Sea (Key West Range Complex) Large Marine Ecosystems. Cratering created by deep underwater explosions is not expected to disturb or damage artifacts on the seafloor and archaeological deposits buried in the ocean sediments in the Study Area because bottom-placed explosives are laid by divers who are able to observe bottom conditions and avoid sensitive areas and all other explosives would detonate near the surface in deep water. Because standard operating procedures are implemented to protect submerged cultural resources and overall types, and locations of training activities are not expected to change from those currently conducted by the Navy (refer to Table 3.0-27), no impacts on submerged historic resources located in the Study Area are expected from cratering by underwater explosions. As discussed in Section 5.4.1 (Mitigation Areas for Seafloor Resources), the Navy will implement mitigation to avoid impacts from explosives on seafloor resources in mitigation areas throughout the Study Area. For example, the Navy will not conduct explosive mine countermeasure and neutralization activities within a specified distance of shipwrecks.

Impacts from Explosives – Cratering under Alternative 2 for Testing Activities

Under Alternative 2, the number of explosive rounds and locations associated with testing activities are the same as under Alternative 1 with the exception of neutralizers and would occur within the Northeast U.S. Continental Shelf (Virginia Capes Range Complex) and the Gulf of Mexico (Naval Surface Warfare Center, Panama City Division Testing Range and Gulf of Mexico Range Complex) Large Marine Ecosystems (refer to Table 3.0-28). Cratering created by deep underwater explosions is not expected to disturb or damage artifacts on the seafloor and archaeological deposits buried in the ocean sediments in the Study Area because bottom-placed explosives are laid by divers who are able to observe bottom conditions and avoid sensitive areas and all other explosives would detonate near the surface in deep water. Because standard operating procedures are implemented to protect submerged cultural resources, and overall types and locations of testing activities are not expected to change from those currently conducted by the Navy (refer to Table 3.0-28), no impacts on submerged historic resources located in the Study Area are expected from cratering by underwater detonations. As discussed in Section 5.4.1 (Mitigation Areas for Seafloor Resources), the Navy will implement mitigation to avoid impacts from explosives on seafloor resources in mitigation areas throughout the Study Area. For example, the Navy will not conduct explosive mine countermeasure and neutralization activities within a specified distance of shipwrecks.

3.10.3.1.2.3 Impacts from Explosives – Cratering under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various explosive stressors (e.g., cratering) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.10.3.2 Physical Disturbance and Strike Stressors

Any physical disturbance on the continental shelf and seafloor, such as ship anchoring, targets or mines resting on the seafloor, moored mines, bottom-mounted tripods, and bottom crawling unmanned underwater vehicles could inadvertently damage or destroy submerged prehistoric sites and historic resources. However, in-water devices are operated to avoid obstructions, such as submerged objects, to minimize damage to the device. In the event that the Navy impacts a submerged historic or prehistoric resource, consultation would be conducted with the appropriate State Historic Preservation Officers. Therefore, a towed system or vessel is very unlikely to encounter a submerged historic resource inadvertently. Expended materials such as chaff, flares, projectiles, casings, target or missile fragments, non-explosive practice munitions, rocket fragments, ballast weights, sonobuoys, torpedo launcher accessories, or mine shapes could be deposited on the ocean bottom on or near submerged prehistoric sites or historic resources. Heavier expended materials could damage intact fragile submerged historic or prehistoric resources if they landed with velocity on a resource.

3.10.3.2.1 Impacts from In-Water Devices under Alternative 1

Impacts from In-Water Devices under Alternative 1 for Training Activities

Under Alternative 1, training activities using towed in-water devices would occur within the Northeast U.S. Continental Shelf (Virginia Capes Range Complex), the Southeast U.S. Continental Shelf (Navy Cherry Point and Jacksonville Range Complexes), and the Gulf of Mexico (Key West and Gulf of Mexico Range Complexes) Large Marine Ecosystems. Because no comprehensive survey or evaluation of submerged historic resources has occurred in the Study Area, unrecorded historic resources could be disturbed by in-water devices. However, because in-water devices are operated in a manner to avoid obstructions and overall types and locations of training activities are not expected to change from those currently conducted by the Navy (refer to Tables 3.0-21, 3.0-22, and 3.0-23), no impacts on submerged historic resources located in the Study Area are expected from in-water devices.

Impacts from In-Water Devices under Alternative 1 for Testing Activities

Under Alternative 1, testing activities using in-water devices would occur within the Northeast U.S. Continental Shelf (Northeast and Virginia Capes Range Complexes) and the Gulf of Mexico (Naval Surface Warfare Center, Panama City Division Testing Range) Large Marine Ecosystems. Because no comprehensive survey or evaluation of submerged historic resources has occurred in the Study Area, unrecorded historic resources could be disturbed by in-water devices. However, because in-water devices are operated in a manner to avoid obstructions, and overall types and locations of testing activities are not expected to change from those currently conducted by the Navy (refer to Tables 3.0-21 and 3.0-22, no impacts on submerged historic resources located in the Study Area are expected from in-water devices.

3.10.3.2.2 Impacts from In-Water Devices under Alternative 2

Impacts from In-Water Devices under Alternative 2 for Training Activities

Under Alternative 2, the number of training activities using in-water devices is the same as under Alternative 1 and would occur within the Northeast U.S. Continental Shelf (Virginia Capes Range Complex), the Southeast U.S. Continental Shelf (Navy Cherry Point and Jacksonville Range Complexes), and the Gulf of Mexico (Key West and Gulf of Mexico Range Complex) Large Marine Ecosystems.

Because no comprehensive survey or evaluation of submerged historic resources has occurred in the Study Area, unrecorded historic resources could be disturbed by underwater detonations. However, because in-water devices are operated in a manner to avoid obstructions, and overall types and locations of testing activities are not expected to change from those currently conducted by the Navy (refer to Tables 3.0-21, 3.0-22, and 3.0-23), no impacts on submerged historic resources located in the Study Area are expected from in-water devices.

Impacts from In-Water Devices under Alternative 2 for Testing Activities

Under Alternative 2, the number of testing activities using in-water devices is the same as under Alternative 1 and would occur within the Northeast U.S. Continental Shelf (Northeast and Virginia Capes Range Complexes) and the Gulf of Mexico (Naval Surface Warfare Center, Panama City Division Testing Range) Large Marine Ecosystems. Because in-water devices are operated in a manner to avoid obstructions, and overall types and locations of testing activities are not expected to change from those currently conducted by the Navy (refer to Table 3.0-21 and 3.0-22), no impacts on submerged historic resources located in the Study Area are expected from in-water devices.

3.10.3.2.3 Impacts from In-Water Devices under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various physical disturbance and strike stressors (e.g., in-water devices) would not be introduced into the marine environment. Consequently, no impacts on cultural resources are expected from underwater explosions. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.10.3.2.4 Impacts from Military Expended Materials

Deposition of non-explosive practice munitions, sonobuoys, and military expended materials may affect submerged cultural resources through possible impact of resources on the seafloor or the simple settling of military expended materials on top of submerged cultural resources. These potential impacts are combined in this discussion.

The large marine ecosystems that overlap the Study Area cover 1,255,365 square nautical miles (NM^2), and contain records of 53,436 known wrecks, obstructions, occurrences, or sites that are marked as “unknown” are potential cultural resources. The large marine ecosystems have the potential to contain submerged prehistoric sites (on the continental shelf associated with the Northeast U.S. Continental Shelf and the Gulf of Mexico Large Marine Ecosystems). The highest density of historic resources ranges from one possible historic resource in 7 NM^2 (combined Newfoundland-Labrador Shelf and Scotian Shelf Large Marine Ecosystems) to one possible historic resource in 79 NM^2 (Southeast U.S. Continental Shelf Large Marine Ecosystem). The likelihood of expended materials either impacting or landing on submerged cultural resources is very low given the size of the regions.

Most of the anticipated expended materials would be small objects and fragments that slowly drift to the seafloor after striking the ocean surface. Larger and heavier objects, such as non-explosive practice munitions, could strike the ocean surface with greater velocity, but their acceleration would slow as they move through the water. It is possible these larger and heavier objects could impact a submerged prehistoric site by creating sediment and artifact displacement. A prehistoric or historic resource could be impacted by damaging structural elements and the probability increases in areas where there is a higher density of resources. However, it is not anticipated because the Navy avoids areas with identified submerged obstructions.

3.10.3.2.4.1 Impacts from Military Expended Materials under Alternative 1

Impacts from Military Expended Materials under Alternative 1 for Training Activities

Under Alternative 1, training activities would occur within existing designated areas in the Northeast U.S. Continental Shelf, the Southeast U.S. Continental Shelf, the Caribbean Sea, and the Gulf of Mexico Large Marine Ecosystems. Expended materials could be deposited on or in the vicinity of submerged prehistoric sites and known and unrecorded historic resources. However, the Study Area is so large and because the Navy avoids areas with known submerged obstructions, it is unlikely these materials would come into contact with a submerged prehistoric site or a historic resource. If they should sink on or in the vicinity of either type of cultural resource, the expended materials would not likely diminish the qualifying characteristics of the submerged prehistoric site or the historic resource.

Impacts from Military Expended Materials under Alternative 1 for Testing Activities

Under Alternative 1, testing activities would occur within existing designated areas in the Northeast U.S. Continental Shelf, the Southeast U.S. Continental Shelf, the Caribbean Sea, and the Gulf of Mexico Large Marine Ecosystems. Under Alternative 1, expended materials could be deposited on or in the vicinity of submerged prehistoric sites and known and unrecorded historic resources. However, because the Study Area is so large, and because the Navy avoids areas with known submerged obstructions, it is unlikely these materials would come into contact with a submerged prehistoric site or a historic resource. If they should sink on or in the vicinity of either type of cultural resource, the expended materials would not likely diminish the qualifying characteristics of the submerged prehistoric site or the historic resource.

3.10.3.2.4.2 Impacts from Military Expended Materials under Alternative 2

Impacts from Military Expended Materials under Alternative 2 for Training Activities

Under Alternative 2, the number of expended materials from training activities would be the same as those described under Alternative 1. Expended materials could be deposited on or in the vicinity of submerged prehistoric sites and known and unrecorded historic resources. However, because the Study Area is so large and because the Navy avoids areas with known submerged obstructions, it is unlikely these materials would come into contact with a submerged prehistoric site or a historic resource. If they should sink on or in the vicinity of either type of cultural resource, the expended materials would not likely diminish the qualifying characteristics of the submerged prehistoric site or the historic resource.

Impacts from Military Expended Materials under Alternative 2 for Testing Activities

Under Alternative 2, the number of expended materials from testing activities would the same as those described under Alternative 1. Expended materials could be deposited on or in the vicinity of submerged prehistoric sites and known and unrecorded historic resources; however, because the Study Area is so large and because the Navy avoids areas with known submerged obstructions, it is unlikely these materials would come into contact with a submerged prehistoric site or a historic resource. If they should sink on or in the vicinity of either type of cultural resource, the expended materials would not likely diminish the qualifying characteristics of the submerged prehistoric site or the historic resource.

3.10.3.2.4.3 Impacts from Military Expended Materials under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various physical disturbance and strike stressors (e.g., military expended material) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.10.3.2.4.4 Impacts from Seafloor Devices

Physical disturbances on the continental shelf and seafloor, such as precision anchoring, targets or mines resting on the ocean floor, moored mines, bottom-mounted tripods, and bottom crawlers (unmanned underwater vehicles) could damage or destroy submerged prehistoric sites or historic resources if such resources are directly impacted. Regarding targets, mines, and similar seafloor devices, because the Study Area is so large, and because the Navy avoids areas with known submerged obstructions, it is unlikely these materials would come into contact with a submerged prehistoric site or a historic resource. Because of their size and weight, if they should settle on or in the vicinity of either type of cultural resource, the seafloor devices would not likely diminish the qualifying characteristics of the submerged prehistoric site or the historic resource. The Navy operates bottom crawlers (unmanned underwater vehicles) only where the safety of the equipment and the success of the mission would be assured. Therefore, the Navy does not deploy these devices where there is a risk of snagging the vehicle on obstacles, such as shipwrecks.

Impacts on previously identified cultural resources from seafloor devices within the Study Area are not anticipated because (1) precision anchoring does not occur near known historic shipwrecks, (2) obstructions, and archaeological sites are routinely avoided during training and testing, and (3) most shipwrecks are located at substantial depths and distributed over large areas of the seafloor.

3.10.3.2.4.5 Impacts from Seafloor Devices under Alternative 1

Impacts from Seafloor Devices under Alternative 1 for Training Activities

Under Alternative 1, training activities using seafloor devices would occur within the Northeast U.S. Continental Shelf (Virginia Capes Range Complex), the Southeast U.S. Continental Shelf (Navy Cherry Point and Jacksonville Range Complexes), and the Gulf of Mexico (Key West and Gulf of Mexico Range Complexes) Large Marine Ecosystems. Because no comprehensive survey or evaluation of submerged historic resources has occurred in the Study Area, unrecorded historic resources could be disturbed by seafloor devices. The Navy would implement mitigation that includes not conducting precision anchoring (except in designated anchorages) within the anchor swing circle of shipwrecks to avoid potential impacts from seafloor devices on cultural resources in mitigation areas throughout the Study Area (see Section 5.4.1, Mitigation Areas for Seafloor Resources). However, because bottom and moored mine anchors are laid by divers who are able to observe bottom conditions and avoid sensitive areas, most seafloor devices would not be used in deep water, overall types and locations of training activities are not expected to change from those currently conducted by the Navy (refer to Tables 3.0-35 and 3.0-36), and considering the implementation of mitigation for precision anchoring, no impacts on submerged historic resources located in the Study Area are expected from seafloor devices.

Impacts from Seafloor Devices under Alternative 1 for Testing Activities

Under Alternative 1, testing activities using seafloor devices would occur within the Northeast U.S. Continental Shelf (Northeast and Virginia Capes Range Complexes), the Southeast U.S. Continental Shelf (Navy Cherry Point and Jacksonville Range Complexes), and the Gulf of Mexico (Naval Surface Warfare Center, Panama City Division Testing Range) Large Marine Ecosystems. Because no comprehensive survey or evaluation of submerged historic resources has occurred in the Study Area, unrecorded historic resources could be disturbed by seafloor devices. However, because seafloor devices associated with testing activities would not be used in deep water and overall types and locations of testing activities are not expected to change from those currently conducted by the Navy (refer to Table 3.0-35) no impacts on submerged historic resources located in the Study Area are expected from seafloor devices.

3.10.3.2.4.6 Impacts from Seafloor Devices under Alternative 2

Impacts from Seafloor Devices under Alternative 2 for Training Activities

Under Alternative 2, the number of training activities using seafloor devices is the same as under Alternative 1 and would occur within the Northeast U.S. Continental Shelf (Virginia Capes Range Complex), the Southeast U.S. Continental Shelf (Navy Cherry Point and Jacksonville Range Complexes), and the Gulf of Mexico (Key West and Gulf of Mexico Range Complexes) Large Marine Ecosystems. Because no comprehensive survey or evaluation of submerged historic resources has occurred in the large marine ecosystems, unrecorded historic resources could be disturbed by seafloor devices. The Navy will implement mitigation that includes not conducting precision anchoring (except in designated anchorages) within the anchor swing circle of shipwrecks to avoid potential impacts from seafloor devices on cultural resources in mitigation areas throughout the Study Area (see Section 5.4.1, Mitigation Areas for Seafloor Resources). Because most sea floor devices would not be used in deep water, overall types and locations of training activities are not expected to change from those currently conducted by the Navy (refer to Tables 3.0-35 and 3.0-36), and considering the implementation of mitigation for precision anchoring, no impacts on submerged historic resources located in the Study Area are expected from seafloor devices.

Impacts from Seafloor Devices under Alternative 2 for Testing Activities

Under Alternative 2, the number of testing activities using seafloor devices is virtually the same as under Alternative 1 and would occur within the Northeast U.S. Continental Shelf (Northeast and Virginia Capes Range Complexes), the Southeast U.S. Continental Shelf (Navy Cherry Point and Jacksonville Range Complexes), and the Gulf of Mexico (Naval Surface Warfare Center, Panama City Division Testing Range) Large Marine Ecosystems. However, because seafloor devices associated with testing activities would not be used in deep water and overall types and locations of testing activities are not expected to change from those currently conducted by the Navy (refer to Table 3.0-35), no impacts on submerged prehistoric sites or submerged historic resources located in the Study Area are expected from the use of seafloor devices.

3.10.3.2.4.7 Impacts from Seafloor Devices under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various physical disturbance and strike stressors (e.g., seafloor devices) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.10.3.2.5 Impacts from Pile Driving

3.10.3.2.5.1 Impacts from Pile Driving under Alternative 1

Impacts from Pile Driving under Alternative 1 for Training Activities

Under Alternative 1, a total of two Elevated Causeway System training events would occur in the Lower Chesapeake Bay and Navy Cherry Point Range Complex. Pile driving for elevated causeway system training would subject nearshore sediments to vibration, disruption, and compaction. Elevated causeway system training would not occur near known submerged cultural resources and the potential for encountering submerged historic resources in those areas is low. Surveys of the planned location of the elevated causeway system training would be conducted to ensure there are no obstructions prior to construction; this would prevent impacts to submerged resources.

Impacts from Pile Driving under Alternative 1 for Testing Activities

Pile driving is not associated with any testing activities under Alternative 1.

3.10.3.2.5.2 Impacts from Pile Driving under Alternative 2

Impacts from Pile Driving under Alternative 2 for Training Activities

Under Alternative 2, the number of elevated causeway system training events would not increase relative to Alternative 1. Therefore, the potential for affecting submerged historic resources would be the same as described under Alternative 1.

Impacts from Pile Driving under Alternative 2 for Testing Activities

Pile driving is not associated with any testing activities under Alternative 2.

3.10.3.2.5.3 Impacts from Pile Driving under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various physical disturbance and strike stressors (e.g., pile driving) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.10.3.2.6 Impacts from Vibration from Sonic Booms

Impulsive noise, such as that resulting from supersonic overflights (sonic booms) can create intense shock waves that cause airborne vibration. Repeated vibration, over time, has the potential to degrade or destroy sensitive structural or cultural elements. Supersonic aircraft flights can occur and are usually limited to altitudes above 30,000 ft. and locations more than 30 NM from shore. Several factors influence sonic booms: weight, size, and shape of the aircraft; altitude; flight paths; and atmospheric conditions. A larger and heavier aircraft displaces more air and creates more lift to sustain flight, compared with small, light aircraft. Therefore, larger aircraft create sonic booms that are stronger and louder than those of smaller, lighter aircraft.

Vibration and shock waves from sonic booms could create increased structural instability and damage to a fragile historic architectural resource in the Study Area (Fort Jefferson in the Key West Range Complex) (Hanson et al., 1991; James et al., 2009).

3.10.3.2.6.1 Impacts from Aircraft Noise—Vibration from Sonic Booms under Alternative 1

Impacts from Vibration from Sonic Booms under Alternative 1 for Training Activities

Only the Key West Range Complex in the Gulf of Mexico Large Marine Ecosystem contains a cultural resource that could be susceptible to sonic booms; no other regions are associated with supersonic flight activities where susceptible cultural resources occur.

The Key West Range Complex contains a National Register of Historic Places-listed resource, Fort Jefferson, which is susceptible to damage from vibration and shock waves generated from sonic booms. A sonic boom study was conducted as part of the Key West Range Complex Environmental

Assessment/Overseas Environmental Assessment (James et al., 2009). Fragile mortar in the brick masonry at Fort Jefferson may be susceptible to damage from sonic booms (Hanson et al., 1991; James et al., 2009); however, the study concluded that restored sections of Fort Jefferson are not susceptible to sonic boom damage (James et al., 2009). The exclusionary Tortuga Military Operations Area around the Dry Tortugas National Park, combined with the Navy's existing avoidance and mitigation measures enacted, means that sonic boom vibration has little potential for structural damage to historic structures and features associated with National Register of Historic Places-listed Fort Jefferson.

Impacts from Vibration from Sonic Booms under Alternative 1 for Testing Activities

No testing activities that could create sonic booms would occur in or near the Dry Tortugas National Park in the Gulf of Mexico Large Marine Ecosystem.

3.10.3.2.6.2 Impacts from Vibration from Sonic Booms under Alternative 2

Impacts Vibration from Sonic Booms under Alternative 2 for Training Activities

As indicated in Alternative 1, only the Key West Range Complex in the Gulf of Mexico Large Marine Ecosystem contains a cultural resource that could be susceptible to sonic booms; no other large marine ecosystems are either associated with activities generating sonic booms or contain susceptible cultural resources.

There would be no increase in aircraft activity in the Key West Range Complex under Alternative 2 compared with Alternative 1. The exclusionary Tortuga Military Operations Area around the Dry Tortugas National Park, combined with the Navy's existing avoidance and mitigation measures, means that sonic boom vibration has little potential for structural damage to historic structures and features associated with National Register of Historic Places-listed Fort Jefferson.

Impacts from Vibration from Sonic Booms under Alternative 2 for Testing Activities

No testing activities that could create sonic booms would occur in or near the Dry Tortugas National Park in the Gulf of Mexico Large Marine Ecosystem.

3.10.3.2.6.3 Impacts from Vibration from Sonic Booms under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various physical disturbance and strike stressors (e.g., vibration from sonic booms) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.10.4 Summary of Potential Impacts on Cultural Resources

3.10.4.1 Combined Impacts of All Stressors under Alternative 1

Explosive and physical disturbance and strike stressors associated with training and testing activities would not impact cultural resources with implementation of mitigation measures.

3.10.4.2 Combined Impacts of All Stressors under Alternative 2

Explosive and physical disturbance and strike stressors associated with training and testing activities associated with explosive and physical stressors would not impact cultural resources with implementation of mitigation measures.

3.10.4.3 Combined Impacts of All Stressors under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities. Baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

3.10.4.4 National Historic Preservation Act

Table 3.10-2 summarizes the potential effects of the Proposed Action on submerged resources in accordance with Section 106 of the National Historic Preservation Act for Alternative 1, Alternative 2, and the No Action Alternative. The Proposed Action is not anticipated to affect known cultural resources within the Study Area. Accordingly, in the event that the Navy impacts a submerged historic or prehistoric resource, consultation would be conducted with the appropriate State Historic Preservation Officers.

Table 3.10-2: Summary of Section 106 Effects of Training and Testing Activities on Cultural Resources

Alternative and Stressor	*Section 106 Effects*
Alternative 1	
Explosive Stressors	Explosive stressors resulting from underwater explosions creating shock waves and cratering of the seafloor would not affect known or unknown submerged cultural resources; mitigation measures would continue to be implemented to protect shipwrecks.
Physical Disturbance and Strike Stressors	Physical stressors resulting from in-water devices, military expended materials, seafloor devices, pile driving, and vibration from sonic booms during training and testing activities would not affect known or unknown submerged cultural resources; mitigation measures, would continue to be implemented to protect shipwrecks.
Regulatory Determination	*No adverse effects on submerged cultural resources would occur.*
Alternative 2	
Explosive Stressors	Explosive stressors resulting from underwater explosions creating shock waves and cratering of the seafloor would not affect known or unknown submerged cultural; mitigation measures would continue to be implemented to protect shipwrecks.
Physical Disturbance and Strike Stressors	Physical stressors resulting from in-water devices, military expended materials, seafloor devices, pile driving, and vibration from sonic booms during training and testing activities would not affect known or unknown submerged cultural resources; mitigation measures, would continue to be implemented to protect shipwrecks.
Regulatory Determination	*No adverse effects on submerged cultural resources would occur.*
No Action Alternative	
Explosive Stressors	Explosive stressors would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities
Physical Disturbance and Strike Stressors	Physical disturbance and strike stressors would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

References

Barnette, M. C. (2010). *Lost at Sea: A Treatise on the Management and Ownership of Shipwrecks and Shipwreck Artifacts*. Retrieved from http://uwex.us/lostatsea.htm.

Bourque, B. J. (1979). *A Summary and Analysis of Cultural Resources Information on the Continental Shelf from the Bay of Fundy to Cape Hatteras*. Harvard University: Prepared by Institute for Conservation Archaeology.

Bureau of Ocean Energy Management, and Regulation and Enforcement. (2011). *Civil War Shipwrecks (1861–1865)*. Retrieved from http://www.gomr.boemre.gov/homepg/regulate/environ/archaeological/civil_war_shipwrecks.html.

Burns, J. M. (2011). *Final Technical Memorandum (Ranges and Operating Areas): Literature Review, Site Files Search, and Predictive Modeling for Submerged Cultural Resources for the U.S. Atlantic Fleet Training and Testing Environmental Impact Statement/Overseas Environmental Impact Statement*. Pensacola, FL: Southeastern Archaeological Research, Inc.

Clark, K. (2008). *Dry Tortugas National Park, Historic Preservation Report: Preserve Fort Jefferson Phase II, Record of Treatment Year One*. Washington, DC: Garden Key, Dry Tortugas National Park, National Park Service.

Coale, K. H., K. S. Johnson, S. E. Fitzwater, R. M. Gordon, S. Tanner, F. P. Chavez, L. Ferioli, C. Sakamoto, P. Rogers, F. Millero, P. Steinberg, P. Nightingale, D. Cooper, W. P. Cochlan, M. R. Landry, J. Constantinou, G. Rollwagen, A. Trasvina, and R. Kudela. (1996). A massive phytoplankton bloom induced by an ecosystem-scale iron fertilization experiment in the Equatorial Pacific. *Nature, 383*, 495–501.

Coastal Environments Inc. (1977). *Cultural Resources Evaluation of the Northern Gulf of Mexico Continental Shelf*. Baton Rouge, LA: U.S. Department of the Interior.

Delgado, J. P. (2013). *Identification of the Wreck of the U.S.C.S.S. Robert J. Walker off Atlantic City, New Jersey*. Silver Spring, MD: National Oceanic and Atmospheric Administrations's Office of National Marine Sanctuaries.

Enright, J. M., R. Gearhart, D. Jones, II, and J. M. Enright. (2006). *Study to Conduct National Register of Historic Places Evaluations of Submerged Sites on the Gulf of Mexico Outer Continental Shelf*. (OCS Study MMS 2006-036). New Orleans, LA: PBS&J.

Faught, M. K. (2004). The underwater archaeology of paleolandscapes, Apalachee Bay, Florida. *American Antiquity, 69*(2), 275–289.

Faught, M. K. (2010). *Continental Shelf Prehistoric Archaeology: A Northwest Florida Perspective*. Retrieved from http://home.comcast.net/~mfaught/continentalshelf/cont_shelf_principles.html.

Federal Aviation Administration. (2009). *Appendix A: National Airspace System Overview*. Retrieved from http://www.faa.gov/air_traffic/nas_redesign/regional_guidance/eastern_reg/nynjphl_redesign/documentation/feis.

Florida Department of State. (1997). *Development of Underwater Archeological Bureau of Archeological Research*. Tallahassee, FL: Florida Department of State, Division of Historic Resources, Bureau of Archaeological Research.

Florida Department of State. (2007). *Florida's "Museums in the Sea."* Retrieved from http://www.museumsinthesea.com/.

Florida Department of State. (2008). *USS Massachusetts*. Retrieved from http://www.flheritage.com/archaeology/underwater/preserves/uwmass.cfm.

Florida Division of Historical Resources. (2011). *Underwater Archaeology: Drowned Prehistoric Sites*. Retrieved from http://www.flheritage.com/archaeology/underwater/sites/sites2.cfm.

Garrison, E. G., C. P. Giammona, F. J. Kellly, A. R. Tripp, and G. A. Wolff. (1989). *Historic Shipwrecks and Magnetic Anomalies of the Northern Gulf of Mexico: Reevaluation of Archaeological Resource Management Zone 1*. New Orleans, LA: Texas A&M Research Foundation.

Gerry E. Studds Stellwagen Bank National Marine Sanctuary. (2018). *Maritime Heritage: Joffre*. Retrieved from https://stellwagen.noaa.gov/maritime/joffre.html.

Hanson, C. E., K. W. King, M. E. Eagan, and R. D. Horonjeff. (1991). *Aircraft Noise Effects on Cultural Resources: Review of Technical Literature*. (290940.04-1). Lexington, MA: M. Harris, Miller & Hanson, Inc.

Howell, E. A., P. H. Dutton, J. J. Polovina, H. Bailey, D. M. Parker, and G. H. Balazs. (2010). Oceanographic influences on the dive behavior of juvenile loggerhead turtles (*Caretta caretta*) in the north Pacific Ocean. *Marine Biology, 157*(5), 1011–1026.

James, M., M. Downing, K. Bradley, and J. Gearrelick. (2009). *Sonic Boom Structural Damage Potential for Fort Jefferson at Dry Tortugas National Park*. Fort Jefferson, FL: Blue Ridge Research and Consulting, LLC and Applied Physical Sciences Inc.

Johnson, K. S., S. C. Riser, and D. M. Karl. (2010). Nitrate supply from deep to near-surface waters of the North Pacific subtropical gyre. *Nature, 465*(7301), 1062–1065.

Judge, J. (2007). *History from the River Bottom: The Archaeology and Artifacts of USS Comberland and CSS Florida Historic Naval Ships Assocation*. Retrieved from http://www.hnsa.org/conf2004/papers/judge.htm.

Krivor, M. C. (2009). *Technical Memorandum: Submerged Cultural Resource Predictive Model for the Gulf of Mexico Range Complex*. Pensacola, FL: Parsons, Inc.

Laughlin, J. (2005). *Underwater Sound Levels Associated with Pile Driving at the Bainbridge Island Ferry Terminal Preservation Project* (WSF Bainbridge Island Ferry Terminal Preservation Project). Seattle, WA: Washington State Department of Transportation.

McKinnon, J. S., D. Scott-Ireton, and B. E. Mattick. (2006). *National Register of Historic Places Multiple Property Documentation Form: 1733 Spanish Plate Fleet shipwrecks*. Washington, DC: United States Department of the Interior and the National Park Service.

Mel Fisher Maritime Heritage Society, Inc. (2001). *A slave ship speaks: The wreck of the Henrietta Marie: Overview*. Retrieved from http://www.melfisher.org/exhibitions/henriettamarie/overview.htm.

Merwin, D. E., D. P. Lynch, and D. S. Robinson. (2003). Submerged prehistoric sites in Southern New England: Past research and future directions. *Bulletin of the Archaeological Society of Connecticut, 65*, 41–56.

Morrison, G. T., J. W. Phillips, and R. A. Rasp. (1974). *National Register of Historic Places Nominations form for the Fort Jefferson National Monument, Garden Key, Dry Tortugas, Florida*. Washington, DC: National Register of Historic Places, U.S. Department of the Interior and National Park Service.

National Oceanic and Atmospheric Administration, and National Marine Sanctuaries. (2017a). *Lancing*. Retrieved from https://monitor.noaa.gov/shipwrecks/lancing.html.

National Oceanic and Atmospheric Administration, and National Marine Sanctuaries. (2017b). *Empire Gem*. Retrieved from https://monitor.noaa.gov/shipwrecks/empire_gem.html.

National Park Service. (2007). *Abandoned Shipwreck Act Guidelines*. Washington, DC: National Park Service. Retrieved from http://www.nps.gov/archeology/submerged/intro.htm.

National Park Service. (2008). *National Landmark USS Monitor*. Retrieved from http://www.nps.gov/nhl/designations/Lists/NC01.pdf.

National Park Service. (2010). *Archaeology Program, PART IV: Shipwrecks in the National Register of Historic Places*. Retrieved from http://www.nps.gov/archaeology/submerged/NRShips.htm#va.

National Register Information System. (2008). *National Register of Historic Places listings for the USS Monitor, Dare County, North Carolina*. Retrieved from https://npgallery.nps.gov/NRHP/AssetDetail?assetID=53b556f8-f27b-40c3-ba5e-13d3bbb1337f.

National Register Information System. (2010). *Archeology Program; Abandoned Shipwreck Act Guidelines; Shipwrecks in the National Register of Historic Places*. Retrieved from https://www.nps.gov/archeology/submerged/intro.htm.

National Register Information System. (2016). *SS Antonio Lopez, National Historic Landmark nomination*. Retrieved from http://www2.pr.gov/oech/oech/Documents/Propiedades%20en%20el%20Registro%20Nacional/Dorado/Naufragio%20Antonio%20L%C3%B3pez.pdf.

Naval Historical Center. (2008). *USS Monitor (1861–1862): Loss of the ship, 31 December 1862*. Retrieved from www.history.navy.mil/brandches/org12-7h.htm.

Neyland, R. S. (2001). *Sovereign Immunity and the Management of United States Naval Shipwrecks and Shipwreck Artifacts*. Washington, DC: U.S. Department of the Navy, Naval Historical Center.

North Carolina Office of State Archaeology. (2010). *North Carolina Archaeology: The USS Huron*. Retrieved from https://archaeology.ncdcr.gov/underwater-archaeology-branch/education/uss-huron.

North Carolina Wreck Diving. (2008). *Ship notes and ship history for the U-352*. Retrieved from http://www.nc-wreckdiving.com/WRECKS/U352/U352.HTML.

Northern Atlantic Dive Expeditions. (2018). *Paul Palmer*. Retrieved from https://northernatlanticdive.com/shipwrecks/paul-palmer/.

Pearson, C. E., S. R. James, Jr., M. C. Krivor, S. D. El Darragi, and L. Cunningham. (2003). *Refining and Revising the Gulf of Mexico Outer Continental Shelf Region High-probability Model for Historic Shipwrecks: Final Report*. (OCS Study MMS 2003-060). New Orleans, LA: Panamerican Consultants, Inc. and Coastal Environments, Inc.

Research Planning Inc., Tidewater Atlantic Research Inc., and W. F. Baird & Associates Ltd. (2004). *Archaeological Damage from Offshore Dredging: Recommendations for Pre-Operational Surveys and Mitigation during Dredging to Avoid Adverse Impacts*. (OCS Study MMS 2004-005): Research Planning Inc., Tidewater Atlantic Research Inc., and W.F. Baird & Associates Ltd. .

Roberts, A. P. (2012). *Revised Draft Literature Review, Site Files Search, and Predictive Modeling for Submerged Cultural Resources for the Environmental Impact Statement/Overseas Environmental Impact Statement for the Phase II TAP for Sovereign National Exclusive Economic Zones Within the U.S. Atlantic Fleet Training and Testing*. Pensacola, FL: Southeastern Archaeological Research, Inc. for Parsons Infrastructure and Technology, Inc.

Science Applications International Corporation. (1981). *A Cultural Resource Survey of the Continental Shelf from Cape Hatteras to Key West*. New Orleans, LA: Science Applications, Inc.

Southeastern Archaeological Research. (2010). *Underwater Archaeological Investigation of the Roosevelt Inlet Shipwreck (7S-D-91A) Volume 1: Final Report*. Dover, DE: Delaware Department fof State.

Southeastern Archaeological Research, Inc. (2009a). *Technical Memorandum: Submerged Cultural Resource Predictive Model for the Jacksonville Range Complex*: Norfolk, VA: Southeastern Archaeological Research and Pensacola, FL: Parsons, Inc.

Southeastern Archaeological Research, Inc. (2009b). *Technical Memorandum: Submerged Cultural Resource Predictive Model for the Cherry Point Range Complex*: Norfolk, VA: Southeastern Archaeological Research and Pensacola, FL: Parsons, Inc.

Southeastern Archaeological Research, Inc. (2009c). *Technical Memorandum: Submerged Cultural Resource Predictive Model for the Virginia Capes Range Complex*: Norfolk, VA: Southeastern Archaeological Research and Pensacola, FL: Parsons, Inc.

The Editors of Encyclopedia Britannica. (2018). *H.L. Hunley Submarine*. Retrieved from https://www.britannica.com/topic/H-L-Hunley.

Uboat.net. (2010a). *U-853*. Retrieved from http://www.uboat.net/boats/u853.htm.

Uboat.net. (2010b). *U-157*. Retrieved from http://www.uboat.net/boats/u157.htm.

Uboat.net. (2010c). *U-869*. Retrieved from http://www.uboat.net/boats/u869.htm.

USS Monitor Center. (2008). *History*. Retrieved from www.monitorcenter.org/history/introduction.

Virginia Department of Historic Resources. (2010). *Virginia Landmark Register: National Register of Historic Places* Retrieved from http://www.dhr.virginia.gov/registers/RegisterMasterList.pdf.

Warren, D. J. (2004). *ROV Investigations of the DKM U-166 Shipwreck Site to Document the Archaeological and Biological Aspects of the Wreck Site: Final Performance Report*. Lafayette, LA: C&C Technologies Survey Services.

Wilde-Ramsing, M., and W. Angley. (1985). *National Register of Historic Places Nomination: Cape Fear Civil War Shipwreck District*. National Register of Historic Places Nomination: Mark Wilde-Ramsing and Wilson Angley.

Zander, C. M., and O. Varmer. (1996). Closing the gaps in domestic and international law: Achieving comprehensive protection of submerged cultural resources. *Contested Waters, 1*(3/4), 1–11.

Final
Environmental Impact Statement/Overseas Environmental Impact Statement
Atlantic Fleet Training and Testing

TABLE OF CONTENTS

List of Figures

List of Tables

3.11 Socioeconomics

SOCIOECONOMICS SYNOPSIS

The United States (U.S.) Department of the Navy (Navy) considered all potential stressors that socioeconomics could potentially be exposed to from the Proposed Action. The following conclusions have been reached for the Preferred Alternative (Alternative 1):

- Accessibility: Limits on accessibility to marine areas used by the public (e.g., fishing areas) in the Navy training and testing areas would be temporary and of short duration (hours). Restrictions would be lifted, and conditions would return to normal upon completion of training and testing activities. Minimal impacts on commercial and recreational fishing and tourism may occur; however, limits on accessibility would not result in a direct loss of income, revenue or employment, resource availability, or quality of experience. No impacts on sources for energy production and distribution, mineral extraction, commercial transportation and shipping, and aquaculture are anticipated.
- Airborne Acoustics: Because the majority of Navy training and testing activities are conducted far from where tourism and recreational activities are concentrated, the impact of airborne noise would be negligible. The public may intermittently hear noise from transiting ships or aircraft overflights if they are in the general vicinity of a training or testing activity, but these occurrences would be infrequent. The infrequent exposure to airborne noise would not result in a direct loss of income, revenue or employment, resource availability, or quality of experience. No impacts on sources for energy production and distribution, mineral extraction, commercial transportation and shipping, and aquaculture are anticipated.
- Physical Disturbance and Strikes: Because the majority of Navy training and testing activities are conducted farther from shore than where most recreational activities are concentrated, the potential for a physical disturbance or strike affecting recreational fishing or tourism is negligible. In locations where Navy training or testing occurs in nearshore areas (e.g., pierside), the Navy coordinates with civilian organizations to assure safe and unimpeded access and use of those areas. Based on the Navy's standard operating procedures and the large expanse of the testing and training ranges, the likelihood of a physical disturbance or strike disrupting sources for energy production and distribution, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, aquaculture, and tourism would be negligible. Therefore, direct loss of income, revenue or employment, resource availability, or quality of experience would not be expected.

3.11.1 Introduction and Methods

This section provides an overview of the characteristics of socioeconomic resources in the Atlantic Fleet Training and Testing (AFTT) Study Area (Study Area) and describes in general terms the methods used to analyze potential impacts on these resources from the Proposed Action.

The Council on Environmental Quality regulations implementing the National Environmental Policy Act state that when economic or social effects and natural or physical environmental effects are interrelated, the Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) will discuss these effects on the human environment (40 Code of Federal Regulations [CFR] section 1508.14). The Council on Environmental Quality regulations state that the "human environment shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment." To the extent that the ongoing and proposed Navy training and testing activities in the Study Area could affect the natural or physical environment, the socioeconomic analysis evaluates how elements of the human environment might be affected. The Navy identified six broad socioeconomic elements based on their association with human activities and livelihoods in the Study Area. Each of these socioeconomic resources is an aspect of the human environment that involves economics (e.g., employment, income, or revenue) and social conditions (e.g., enjoyment and quality of life) associated with the marine environment of the Study Area. Therefore, this evaluation considered potential impacts on six elements:

- sources for energy production and distribution (water, wind, oil and gas)
- mineral extraction
- commercial transportation and shipping
- commercial and recreational fishing
- aquaculture
- tourism

The baseline for identifying the socioeconomic conditions in the Study Area was derived using relevant published information from sources that included federal, state, regional, and local government agencies and databases, academic institutions, conservation organizations, technical and professional organizations, and private groups. Previous environmental studies were also reviewed for relevant information.

The alternatives were evaluated based on the potential and the degree to which training and testing activities could impact socioeconomic resources. The potential for impacts depends on the likelihood that the training and testing activities would interface with public activities or infrastructure. Factors considered in the analysis include whether there would be temporal or spatial interfaces between the public or infrastructure and Navy training and testing. If there is potential for this interface, factors considered to estimate the degree to which an exposure could impact socioeconomics include whether there could be an impact on livelihood, quality of experience, resource availability, income, or employment. If there is no expected potential for the public to interface with an activity, the impacts would be considered negligible.

3.11.2 Affected Environment

This section describes the six socioeconomic resources associated with human activities and livelihoods in the Study Area. The primary area of interest for assessing potential impacts on socioeconomic resources is the U.S. territorial waters in the North Atlantic Ocean and the Gulf of Mexico (seaward of the mean high water line to 12 nautical miles [NM]). Limited socioeconomic resources outside this area of interest (i.e., that portion of the U.S. Exclusive Economic Zone between 12 and 200 NM from shore) are also described when relevant to human activities.

3.11.2.1 Sources of Energy Production and Distribution

There are three primary sources of energy production in the Study Area: water, wind, and oil and gas. Each of these activities is described in this section.

3.11.2.1.1 Water

Hydropower is derived from the force of moving water. Hydrokinetic power is a type of hydropower that is derived from fast-moving marine or estuarine currents driven by waves, tides, or offshore ocean currents (U.S. Department of Energy, 2015b). The Federal Energy Regulatory Commission licenses hydropower projects. The Bureau of Ocean Energy Management has jurisdiction to issue leases, easements, and rights-of-way for hydrokinetic projects in Federal waters.

The Wind and Water Power Technologies Office within the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy provided over $133 million in funding for 97 marine and hydrokinetic projects from Fiscal Year 2008–2014, almost exclusively to private industry and universities or colleges. Projects in 24 states, including 11 states located adjacent to the AFTT Study Area, have received funding. Nearly 45 percent ($58 million) of the funding went to the Atlantic coast and Gulf coast geographic regions, with Maine receiving over $18 million. Some of the strongest wave and tidal resource potential in the continental United States resides off the coast of Maine (U.S. Department of Energy, 2015b).

The Federal Energy Regulatory Commission has issued licenses for four hydrokinetic projects, two of which are tidal projects located on the Atlantic coast: the Cobscook Bay Tidal Project in Maine and the Roosevelt Island Tidal Energy Project in New York City. Neither of these projects are located within the AFTT Study Area, but both demonstrate the feasibility of similar projects located farther offshore. In 2012, the Cobscook Bay Tidal Project in Maine marked the first time in U.S. history that a commercial tidal project connected to the electric power grid. Verdant Power, Inc. completed the Roosevelt Island Tidal Energy Project in New York City's East River and continues to develop the technology. The Cobscook Bay license extends through January 31, 2020, and the Roosevelt Island license extends through December 31, 2022 (Federal Energy Regulatory Commission, 2015). A license allows the licensee to construct and operate a hydrokinetic electric generation facility for up to either 30 or 50 years, depending on the type of license.

The United States has no commercial offshore hydrokinetic energy generating capacity at this time. As of April 2018, the Federal Energy Regulatory Commission had two active hydrokinetic preliminary permits. Both of the permitted projects are located on the Atlantic coast. The permit for the Western Passage Tidal Energy project located off the coast of Maine near the city of Eastport was issued on July 13, 2016, and expires on June 30, 2019. The project will test 15 hydrokinetic tidal devices, each consisting of a 500-kilowatt turbine-generator unit (MarineEnergy.biz, 2017). The Cape Cod Canal and Bourne Tidal project located in the Cape Cod Canal in Massachusetts was issued a permit on September 22, 2016, and the permit expires on August 31, 2019 (Federal Energy Regulatory Commission, 2015, 2018a, 2018b). Both projects are located in state waters. Although a preliminary permit does not authorize construction of a commercial device, it allows the applicant to conduct studies and secure data necessary to determine the feasibility of commercial development. The Fort Pierce Inlet Tidal project located off the Florida coast was active from May 2015 through April 2018 and was the first lease issued to test ocean current energy equipment in Federal waters. The project study area and lease blocks permitted by the Bureau of Ocean Energy Management are within the Study Area; however, the project permit is no longer active.

The Navy is playing a role in the development of hydrokinetic technologies by allowing developers to test scale models of their wave energy converter equipment in the wave-making facility at Naval Surface Warfare Center, Carderock in Maryland (U.S. Department of Energy, 2015a). On a broader scale, the U.S. Department of Agriculture and the Navy signed a Memorandum of Understanding in early 2010 to advance the production of renewable energy by sharing technical, program management, and financial expertise (U.S. Department of the Navy, 2010).

A variety of other companies and academic institutions continue to conduct research on and develop hydrokinetic technologies for deployment and eventual commercial use along the Atlantic and Gulf coasts. Their activities may include sea trials, small-scale prototype testing, and research that may use instruments such as acoustic Doppler profile current sensors, digital recording sonar, and underwater video and still photography taken from unmanned underwater vehicles.

3.11.2.1.2 Wind

Wind energy is derived from the force of moving air that causes large wind turbine blades to rotate. The blades are connected to an electric generator that converts the mechanical energy from the wind into electricity, which is then transferred to the electrical power grid (U.S. Department of Energy, 2017). The first commercial offshore wind farm in the United States came online and reached commercial operation in December 2016. The Block Island Wind Farm, located in state waters off Block Island, Rhode Island, was developed by Deepwater Wind, LLC and is capable of generating 30 megawatts of power using five wind turbines (Deepwater Wind, 2018a, 2018b).

A National Offshore Wind Strategy: Creating an Offshore Wind Energy Industry in the United States, was prepared in 2011 to support development of a world-class offshore wind industry in the United States (U.S. Department of Energy & U.S. Department of the Interior, 2011). The Bureau of Ocean Energy Management developed a regulatory framework to review proposed offshore wind projects in federal waters and launched the “Smart from the Start” initiative to facilitate siting, leasing, and construction of new projects (Bureau of Ocean Energy Management, 2013). In general, this process includes the following steps:

- Wind energy areas that appear most suitable for wind energy development are identified.
- Requests for interest and calls for information are issued for new wind energy areas to support lease sale environmental assessments.
- Environmental assessments are completed for the wind energy areas, allowing the lease sale process to move forward.
- A lease sale is held. Issuance of a commercial lease gives the lessee the exclusive right to subsequently seek Bureau of Ocean Energy Management approval for development of the leasehold. The lease does not grant the lessee the right to construct any facilities; rather, the lease grants the right to use the leased area to gather resource and site characterization information and develop plans, which must be approved by the Bureau of Ocean Energy Management before the lessee can move on to the next stage of the process.
- Project-specific National Environmental Policy Act review (typically an EIS) is conducted, and plans for construction and operation are approved before beginning construction of individual wind power facilities.

Since 2009, the Bureau of Ocean Energy Management’s Office of Renewable Energy Programs has issued 13 commercial wind energy leases for offshore wind farm development to the following companies for projects located within or adjacent to the Study Area (Bureau of Ocean Energy Management, 2018):

- Cape Wind Associates, LLC, for an area totaling 29,425 acres (ac.) offshore of Massachusetts (2010).

- Bluewater Wind Delaware, LLC, for an area totaling 96,430 ac. offshore of Delaware (2012). Assigned to Garden State Offshore Energy, LLC, in 2016.
- Deepwater Wind New England, LLC, for two lease areas totaling 164,750 ac. offshore of Rhode Island and Massachusetts (2013).
- Virginia Electric and Power Company (Dominion Virginia Power) for an area totaling 112,799 ac. offshore of Virginia (2013).
- US Wind, Inc. for an area totaling 183,353 ac. offshore of New Jersey (2016).
- US Wind Inc., for two lease areas totaling 79,707 ac. offshore of Maryland (2014).
- Offshore MW LLC for an area totaling 166,886 ac. offshore of Massachusetts (2015). Offshore MW LLC changed its name to Vineyard Wind LLC. In 2017.
- RES America Developments, Inc., for an area totaling 187,523 ac. offshore of Massachusetts (2015). Assigned to Bay State Wind LLC in 2016.
- RES America Developments, Inc. for an area totaling 160,480 ac. offshore of New Jersey (2016). Assigned to Ocean Wind LLC in 2016.
- Statoil Wind US LLC. for an area totaling 79,350 acres offshore of New York (2017).
- Avangrid Renewables, LLC. for an area totaling 122,405 acres offshore of North Carolina (2017).

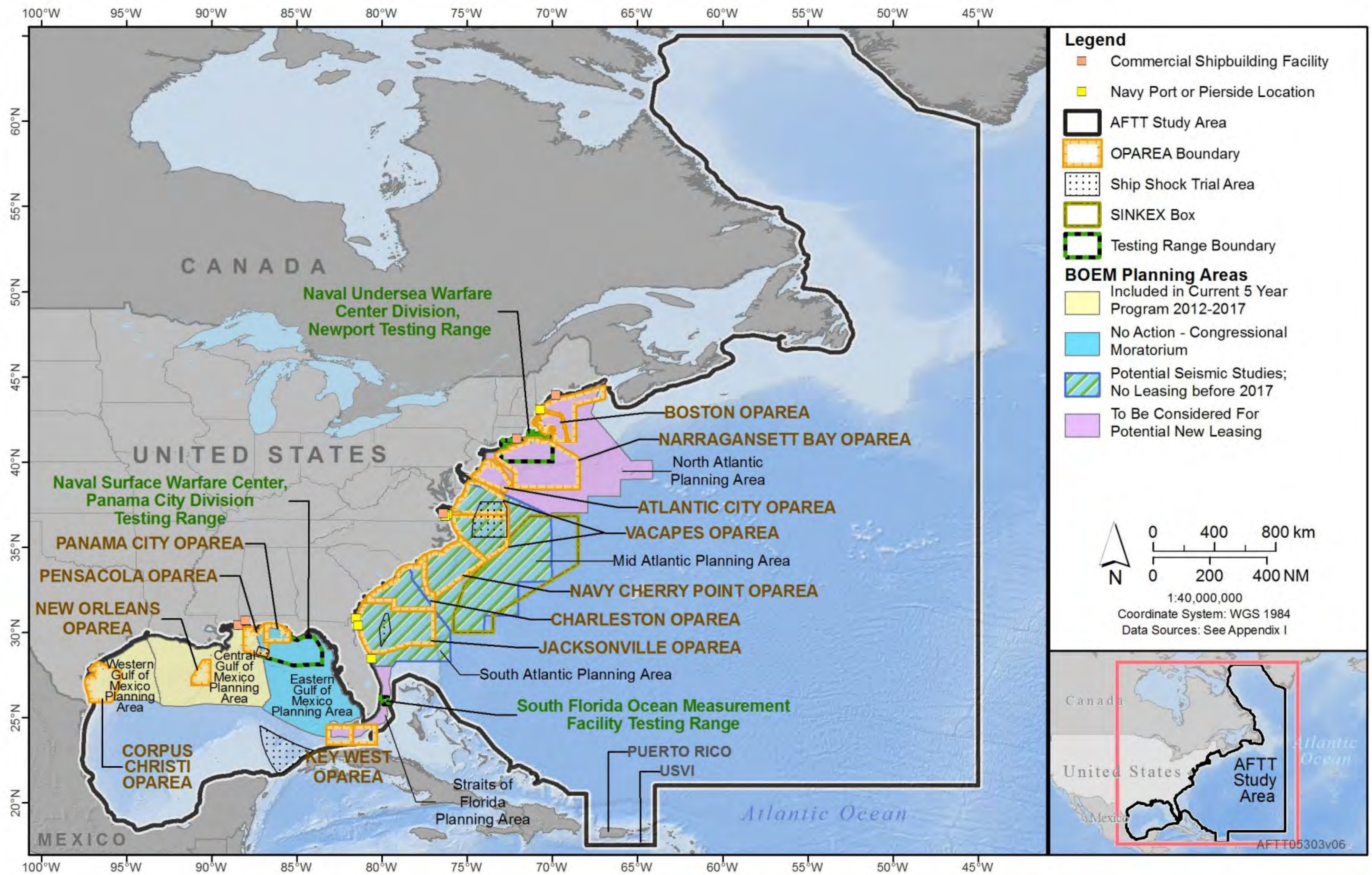
The Bureau of Ocean Energy Management grants rights-of-way allowing developers to build electricity transmission lines connecting commercial windfarms and other offshore renewable energy installations to the on-shore electrical grid. The Bureau executed a right-of-way grant in 2014 for a cable project that will support the Block Island Wind Farm, a wind project located in Rhode Island state waters. The Bureau expects to receive additional unsolicited applications for right-of-way grants in the future (Bureau of Ocean Energy Management, 2015a). Other offshore windfarm projects are expected in the coming years for both research and commercial development in state and federal waters.

Approximately 3 NM offshore of Atlantic City, New Jersey, and within state waters, Fishermen's Energy of New Jersey plans to install six four-megawatt turbines in support of a demonstration and research project. The Fishermen's Energy project had been delayed but was revived by New Jersey state government legislation. The project will test new and developing technology and conduct research on potential environmental impacts associated with offshore windfarms (Post, 2018).

Two research lease requests were received from the Virginia Department of Mines, Minerals and Energy. In response to both requests, the Bureau determined there was no competing interest in the lease areas. One of the research leases, referred to as the Virginia Offshore Wind Technology Advancement Project, was executed in March 2015. This was the first research lease to be issued in U.S. federal waters (Bureau of Ocean Energy Management, 2015b). The Bureau finalized an Environmental Assessment and issued a Finding of No Significant Impact for the proposed project in July 2015. As part of this project, Dominion Virginia Power will install two six-megawatt direct-drive wind turbines 26 miles (mi.) off the coast of Virginia Beach, Virginia.

3.11.2.1.3 Oil and Gas

The Bureau of Ocean Energy Management administers Outer Continental Shelf Oil and Gas Leasing Programs. The Bureau divides the outer continental shelf into planning areas, which are further divided into lease blocks that can be leased from the government by the public (e.g., oil and gas companies) for resource extraction (Figure 3.11-1).



Notes: AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area; BOEM: Bureau of Ocean Energy Management; SINKEX: Sinking Exercise; VACAPES: Virginia Capes

Figure 3.11-1: Bureau of Ocean Energy Management Planning Areas

As of January 1, 2016, there were 4,457 active oil and gas leases totaling 23,989,693 ac. in the Gulf of Mexico Continental Shelf Oil Region, which is divided into three planning areas (Bureau of Ocean Energy Management, 2016):

- Western Planning Area, 907 active leases and 5,143,073 ac. leased
- Central Planning Area, 3,505 active leases and 18,574,590 ac. leased
- Eastern Planning Area, 48 active leases and 264,030 ac. leased

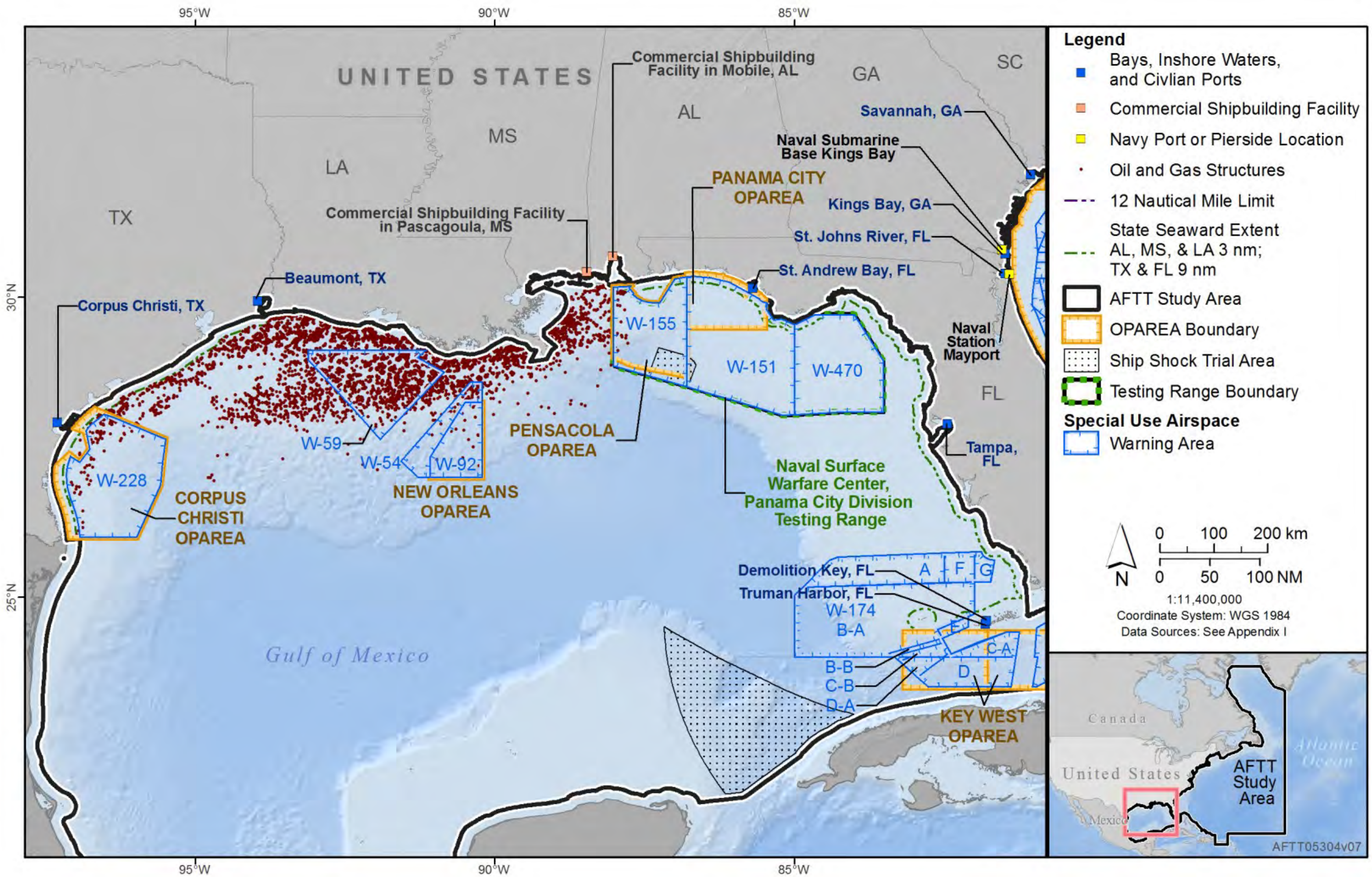
There are 1,866 fewer active leases in the Gulf of Mexico than in 2011, which represents a decrease of 9,916,106 leased acres (Bureau of Ocean Energy Management, 2011, 2016).

Drilling for oil and gas has taken place in offshore Canadian Atlantic waters since 1967; however, Canada has imposed a moratorium on drilling in the Canadian portion of the Georges Bank until December 31, 2022 (Nova Scotia Canada, 2015). Gas was discovered in 1971 off of Sable Island approximately 225 kilometers offshore of Nova Scotia, which is within the Study Area. Natural gas production began in 1999 and continues today. Gas is transported through an undersea pipeline linking production wells with on-shore facilities. The Sable Offshore Energy Project produced over 112 million cubic meters of natural gas in November 2015. However, average monthly production has decreased steadily since 2008, when approximately 400 million cubic meters were produced monthly. The project life expectancy was 25 years when drilling started in 1999, which, unless revised, means the project will end in 2024 (Canada-Nova Scotia Offshore Petroleum Board, 2015).

The Gulf of Mexico is the only portion of the Study Area where energy production from oil and gas occurs in U.S. territorial waters. In 2014, total oil production in the Gulf of Mexico was nearly 395 million barrels and valued at $37 billion (National Ocean Economics Program, 2015a). Natural gas production in 2014 totaled over 829 million Mcf (the unit “Mcf” is 1,000 [M] cubic feet [cf]), which was valued at $3.8 billion. The majority of oil and gas structures and the pipelines linking those structures with on shore processing and refining facilities are located off of Louisiana and do not overlap with Navy testing ranges and Operating Areas (OPAREA) (Figure 3.11-2, Figure 3.11-3).

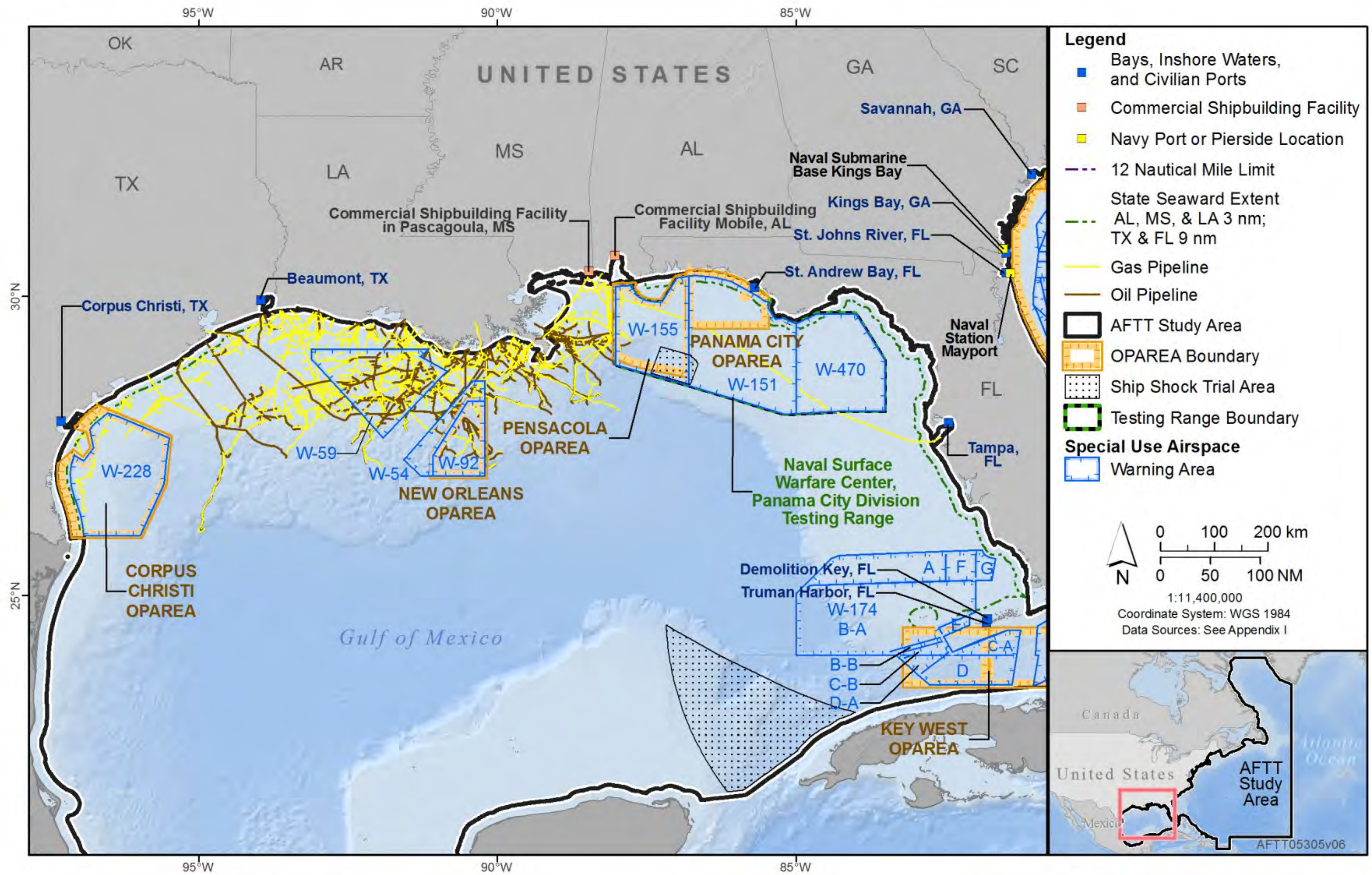
3.11.2.2 Mineral Extraction

Extraction of minerals along the Atlantic and Gulf coasts involves primarily hard minerals (e.g., sand, gravel, and other minerals) extracted from the outer continental shelf. Heavy minerals (e.g., titanium and zircon) used in a number of commercial industries are also potential offshore resources. The Bureau of Ocean Energy Management is responsible for assessing the mineral resources on the U.S. outer continental shelf to determine if they can be extracted in an environmentally sound manner.



Notes: AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area

Figure 3.11-2: Oil and Gas Structures in the Gulf of Mexico



Notes: AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area

Figure 3.11-3: Active and Proposed Oil and Gas Pipelines in the Gulf of Mexico

Two types of lease conveyances for sand and gravel and other non-energy minerals are used by the Bureau: (1) noncompetitive negotiated agreements, which can only be used for public works projects funded by federal, state, or local government agencies; and (2) competitive lease sales, for which any qualified person may submit a bid. Between 2009 and 2016, the Bureau executed 21 leases in six states: Florida, Louisiana, North Carolina, South Carolina, New Jersey, and Virginia (Bureau of Ocean Energy Management, 2015c). Projects include:

- New Jersey (Long Beach Island),
- Virginia (Dam Neck, Sandbridge, and Wallops Flight Facility),
- North Carolina (Bogue Banks),
- South Carolina (Charleston Offshore Dredged Material Disposal Site Sand Borrow Project, Folly Beach),
- Florida (Patrick Air Force Base, Longboat Key, Martin County, Pinellas County, Duval County, and Brevard South Reach), and
- Louisiana (Whiskey Island, Caminada Headlands, Cameron Parish, and Raccoon Island Phase B).

Sand and gravel transported from offshore sites are primarily used to restore coastal areas that have been eroded by storms or sea level rise. Over the past 20 years, more than 109 million cubic yards of sediment have been extracted and transported to coastal communities and federal agencies, including the Navy, for shoreline restoration projects (Bureau of Ocean Energy Management, 2015c). A number of areas along the U.S. Atlantic coast were severely damaged in 2012 by Hurricane Sandy. The Bureau has coordinated with other federal agencies, including the Federal Emergency Management Agency and the U.S. Army Corps of Engineers, on restoration projects at Sandbridge Beach, Virginia; Wallops Island, Virginia; Brevard County, Florida; and Long Beach Island, New Jersey (Bureau of Ocean Energy Management, 2015d).

In February 2014, the Bureau released its Final Programmatic EIS analyzing potential impacts of geological and geophysical surveys of the seafloor; the Record of Decision was signed in July 2014 (Bureau of Ocean Energy Management, 2014). The survey region extends from Delaware Bay to Cape Canaveral, Florida. Geological and geophysical surveys are conducted prior to initiating mineral extraction or offshore development projects, such as windfarms, oil and gas exploration, or hydropower projects, to determine the best use of an area. The Bureau of Ocean Energy Management regulates offshore activities to protect the environment and ensure safety of personnel and the public (Bureau of Ocean Energy Management, 2015c).

3.11.2.3 Commercial Transportation and Shipping

Commercial transportation and shipping encompasses marine and air traffic within the Study Area. Military use of the offshore sea and air space is generally compatible with civilian use, with Navy ships accounting for less than 1 percent of the total ship presence in the Study Area (Mintz, 2012). Training and testing activities that are not compatible with commercial transportation and shipping (e.g., weapons firing) typically occur in Navy OPAREAs far from commercially used waterways and inside Special Use Airspace, as described in Section 3.11.2.3.2 (Air Transport). Upcoming training and testing activities are announced to commercial vessel and aircraft operators by use of Notices to Mariners issued by the U.S. Coast Guard, Notices to Airmen issued by the Federal Aviation Administration, and marine band radio, as needed. The Navy procedures for planning and management of activities are provided in the Chief of Naval Operations Instruction 3770.2K, Airspace Procedures and Planning Manual (U.S. Department of the Navy, 2007).

Scheduling and planning procedures for activities on range complexes (including testing activities in the Northeast Range Complexes) are issued through the Navy's Fleet Area Control and Surveillance Facilities Virginia Capes in Virginia Beach, Virginia and the Fleet Area Control and Surveillance Facilities Jacksonville located in Jacksonville, Florida. Testing ranges have their own procedures for aviation safety, such as the Naval Surface Warfare Center, Panama City Division Instruction (U.S. Department of the Navy, 2008) and Naval Undersea Warfare Center Division, Newport Instruction (U.S. Department of the Navy, 2009).

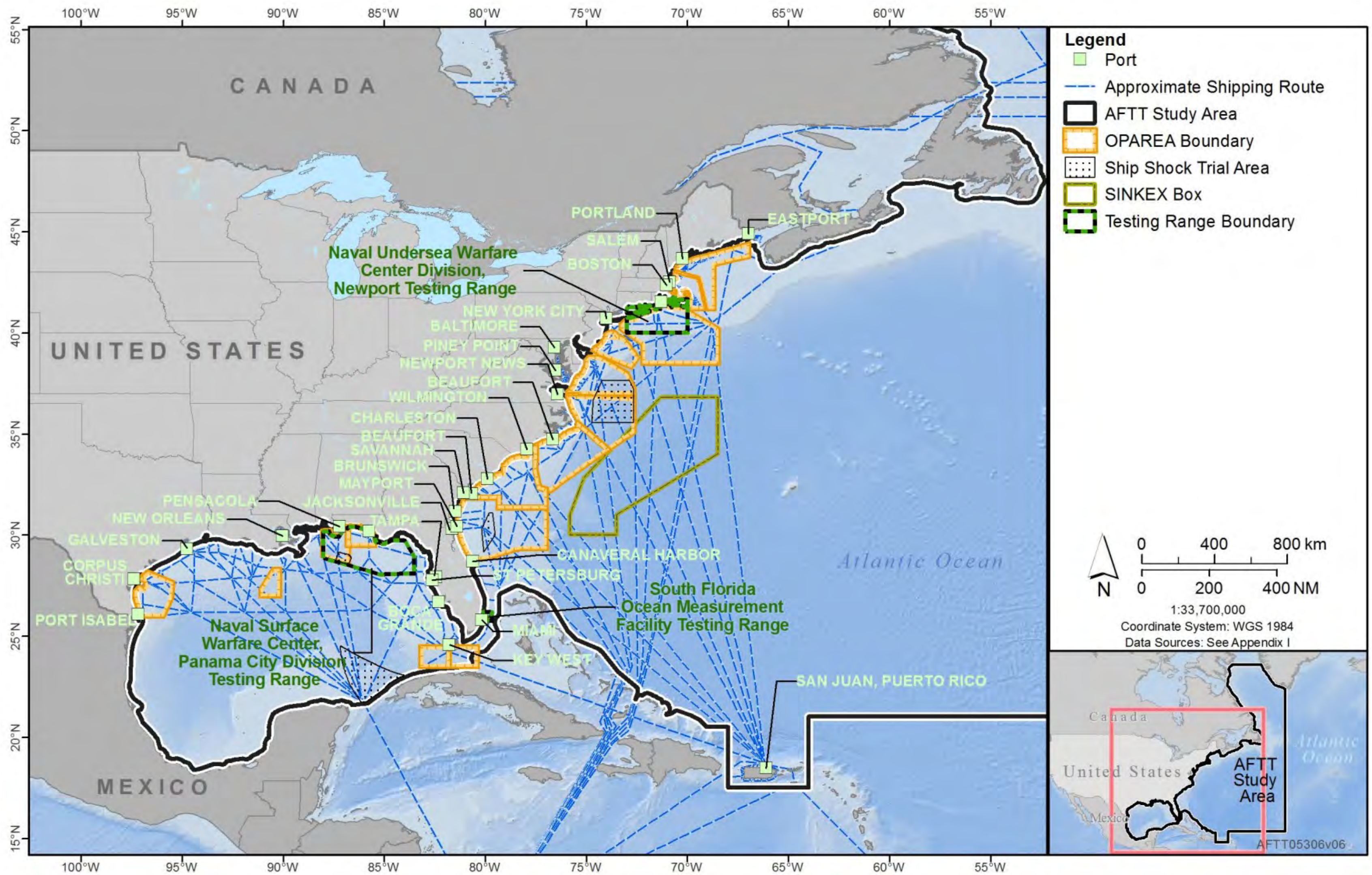
3.11.2.3.1 Ocean Transportation

Ocean transportation is the transit of commercial, private, and military vessels at sea, including submarines. The U.S. Atlantic coast and the Gulf of Mexico are heavily traveled by marine vessels, with numerous waterways and commercial shipping lanes traversing the range complexes (Figure 3.11-4).

Most of the waterways in the Study Area are accessible to commercial vessels; however, some areas are restricted. These restrictions can be permanent or temporary. The National Oceanic and Atmospheric Administration issues nautical charts that reflect designated restricted zones. In accordance with Title 33 CFR part 72, the U.S. Coast Guard and Department of Homeland Security publish marine information pertaining to waterways (i.e., danger zones and restricted areas; see below). Notices to Mariners provide information to private and commercial vessels on temporary closures. These navigational warnings are disseminated by broadcast notices on maritime frequency radio, weekly publications by the appropriate U.S. Coast Guard Navigation Center, and global positioning system navigation charts. They provide information about duration and location of closures due to activities that are potentially detrimental to surface vessels. Vessels are responsible for being aware of designated danger areas in surface waters and any Notices to Mariners that are in effect. Operators of recreational or commercial vessels have a duty to abide by maritime requirements as administered by the U.S. Coast Guard.

The flow of vessel traffic in congested waters, especially near coastlines, is controlled by the use of directional shipping lanes for large vessels, including cargo ships, container ships, and tankers, and flow controls for all vessels in harbors, bays, and ports to ensure that ports-of-entry remain as uncongested as possible. Navy vessels and non-military vessels alike adhere to regulations governing shipping traffic in these areas. There are fewer restrictions controlling open-ocean vessel traffic. In most cases, the factors that influence vessel traffic include: adequate depth of water, weather conditions (primarily affecting smaller recreational vessels), availability and location of fish for commercial and recreational fishing vessels, and hazards to navigation. Large commercial shipping vessels generally follow well-established routes that enable efficient transport of goods between ports. Recreational boating activities fluctuate seasonally, with increased activity in summer when warmer weather and more daylight hours offer more opportunity for recreational boating activities.

Certain areas of surface water within the Study Area are designated as danger zones, safety zones, security zones, or restricted areas as described in the CFR and established by the U.S. Coast Guard and the U.S. Army Corps of Engineers. These areas may limit access to non-military activities on either a fulltime or temporary timeframe. Detailed information on these areas is provided in the CFR as referenced in the following brief descriptions.



Notes: AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area; SINKEX: Sinking Exercise

Figure 3.11-4: Commercially Used Waterways and Major Ports in the Study Area

Information on danger zones and restricted areas is found in 33 CFR part 334 (Navigation and Navigable Waters, Danger Zone and Restricted Area Regulations). A danger zone is a defined water area (or areas) used for target practice, bombing, rocket firing, or other especially hazardous activities. Danger zones may be closed to the public on a fulltime or intermittent basis, as stated in the regulations specific to individual danger zones. A restricted area is a defined water area prohibiting or limiting public access to provide security for government property and to protect the public from risk of injury or damage to property arising from the government's use of the area.

Information on safety zones and security zones is found in 33 CFR part 165 (Regulated Navigation Areas and Limited Access Areas). Safety zones are specifically addressed in 33 CFR part 165.20 Subpart C (Safety Zones). A safety zone is defined as a water area, shore area, or a combination of water and shore area to which, for safety or environmental purposes, access is limited to authorized persons, vehicles, or vessels. A safety zone may be stationary and described by fixed limits, or it may be described as a zone around a vessel in motion. Security zones are defined in 33 CFR part 165.30 Subpart D (Security Zones). A security zone is defined as an area of land, water, or a combination of land and water areas that are designated by the Captain of the Port or District Commander for a time period deemed necessary to prevent damage or injury to any vessel or waterfront facility; to safeguard ports, harbors, territories, or waters of the United States; or to ensure that the rights and obligations of the United States are observed.

In addition to the regulations described above, a naval vessel protection zone as described in 33 CFR part 165.20 Subpart G (Protection of Navy Vessels) states that no vessel or person is allowed within 100 yards of a large U.S. Navy vessel unless authorized by the U.S. Coast Guard, the senior naval officer present in command, or an official patrol.

Furthermore, all vessels shall operate at the minimum speed necessary to maintain a safe course, unless required to maintain a greater speed by navigational rules, and shall proceed as directed by the U.S. Coast Guard, the senior naval officer present in command, or the official patrol.

When a vessel is within a naval vessel protection zone the following rules apply:

- To request authorization to operate within 100 yards of a large U.S. Navy vessel, contact the U.S. Coast Guard, the senior naval officer present in command, or the official patrol on VHF-FM channel 16.

When conditions permit, the U.S. Coast Guard, senior naval officer present in command, or the official patrol should:

- Give advance notice on VHF-FM channel 16 of all large U.S. naval vessel movements;
- Permit vessels constrained by their navigational draft or restricted in their ability to maneuver to pass within 100 yards of a large U.S. naval vessel in order to ensure a safe passage in accordance with the navigation rules;
- Permit commercial vessels anchored in a designated anchorage area to remain at anchor when within 100 yards of passing large U.S. naval vessels; and
- Permit vessels that must transit via a navigable channel or waterway to pass within 100 yards of a moored or anchored large U.S. naval vessel with minimal delay consistent with security.

Danger zones, restricted areas, safety zones, and security zones located in the Study Area are described in Section 3.11.3.1 (Impacts on Accessibility). A representation of the density of commercial and military vessel traffic in the Study Area is shown in Figures 3.0-10 and 3.0-11 in Section 3.0 (Introduction). Sections 3.11.2.3.1.1 (Northeast Range Complex) through 3.11.2.3.1.12 (Pierside Locations [Gulf of Mexico]) provide more detailed information on ocean transportation within the range complexes located within the Study Area.

3.11.2.3.1.1 Northeast Range Complex

The Boston Range Complex, Narragansett Bay Range Complex, and Atlantic City Range Complex are referred to collectively as the Northeast Range Complexes. These range complexes include Special Use Airspace with associated warning areas and surface and subsurface sea space. See Chapter 2 (Description of Proposed Action and Alternatives) for maps and additional details on range complexes in the Study Area.

Military Ocean Traffic

The Fleet Forces Atlantic Exercise Coordination Center is responsible for coordinating OPAREA training assignments, ranges, airspace, mobile sea range assets, fixed and mobile targets, Large Area Tracking Range, and electronic attack. Testing activities are conducted in accordance with Narragansett Bay Shallow Water Test Facility Instruction 8590.1E (U.S. Department of the Navy, 2009). The Fleet Forces Atlantic Exercise Coordination Center coordinates with all Department of Defense (DoD), government, and civilian agencies to ensure compliance with all requirements and regulations for the safe use of ranges, assets, and services. Detailed information on vessel types and the general distribution of vessels within the Study Area is provided in Section 3.0.3.3.4.1 (Vessels and In-Water Devices).

Civilian Ocean Traffic

The U.S. Atlantic coast has some of the busiest shipping lanes in the world, and a large volume of ship traffic transits the area. Maritime traffic includes ships traveling along the coastline between ports in New England and the mid-Atlantic as well as to ports in eastern Canada and across the Atlantic to Europe (Figure 3.11-4).

Commercial (domestic and international) shipping constitutes the majority of this traffic while commercial ferries operate from every coastal state from Maine to Maryland, with the exception of New Hampshire. One primary shipping lane is off northern New England, with many arteries leading to ports in Massachusetts, New Hampshire, and Maine. The majority of the eastern portion of the Boston Range Complex is free from commercial traffic, but commercial traffic can be expected in the western part of the OPAREA. Several primary shipping lanes crisscross the Narragansett Bay Range Complex, leading to the major ports of New York City, New York; Newark, New Jersey; and Providence, Rhode Island. Similarly, the Atlantic City Range Complex contains several primary shipping lanes leading from New York City and Newark to ports in Delaware Bay and the mid-Atlantic United States. It is therefore highly likely that commercial ship traffic would be encountered along shipping routes throughout the greater part of all the Northeast Range Complexes.

Some of the busiest ports in the United States are located adjacent to the Northeast Range Complexes. The port complex of New York City/New Jersey was ranked third in total trade in the United States in 2016. Over 133 million tons of goods passed through the port in 2016 (U.S. Army Corps of Engineers, 2017). New England's largest port, Boston, is ranked 37th in total trade with just over 17 million tons of imports and exports, and the Port of Boston is rapidly becoming one of the fastest-growing high-end cruise ship markets in the country. The port complex of New York City/New Jersey has more scheduled services to a wider variety of trade lanes than any other port in North America. The port complex also processes more 20-foot container units than any other port on the Atlantic coast of the United States. Only the California ports of Long Beach and Los Angeles process more containers (U.S. Maritime Administration, 2015). The port complex of Halifax, Canada, is closer to northern Europe than any other major North American port, and the complex is frequently used as the first inbound port or last outbound port for vessels transiting between Europe and in North America. Vessels traveling along this route will pass through the northern portion of the Study Area.

In 2016, there were over 11.8 million recreational vessels registered in the United States; approximately 1.3 million (11 percent) were registered in the eight states along the coast from Maine to Maryland (U.S. Coast Guard, 2017). Over 90 percent of registered recreational vessels in United States in 2016 were 26 feet (ft.) in length or less, suggesting that most of these vessels are unlikely to travel far from shore for extended periods of time (U.S. Coast Guard, 2017). Recreational boating trips originating along the coast from Maine to Maryland could potentially travel into the Northeast Range Complexes. Many sites known to be fishing hotspots attract both recreational fishers and divers depending on the species and season. These fishing and diving hotspots (including artificial reefs and shipwrecks) may be used throughout the year, but use is highest during summer. Most recreational boat traffic is within a few miles of shore, while potentially hazardous U.S. Navy activities occur farther offshore.

Many popular dive sites are located at the mouth of Massachusetts Bay within the Gerry E. Studds Stellwagen Bank National Marine Sanctuary. The 638 square nautical miles (NM^2) marine sanctuary also offers several submerged shipwrecks (National Oceanic and Atmospheric Administration, 2010).

3.11.2.3.1.2 Naval Undersea Warfare Center Division, Newport Testing Range

The Naval Undersea Warfare Center Division, Newport Testing Range includes the waters of Narragansett Bay, Rhode Island Sound, Block Island Sound, Buzzards Bay, Vineyard Sound, and Long Island Sound. Three restricted areas are within the Naval Undersea Warfare Center Division, Newport Testing Range:

- The Coddington Cove restricted area (adjacent to Naval Undersea Warfare Center Division, Newport Testing Range) provides an area with piers and ships representative of a working harbor area for harbor/swimmer defense type testing.
- The Narragansett Bay Restricted Area (6.1 NM^2 area surrounding Gould Island) includes the Hole Test Area, which provides a deepwater test capability, and the Gould Island Acoustic Communications and Tracking Range, an undersea range, within the boundaries of the North Test Area.
- The Rhode Island Sound Restricted Area is a rectangular box (27.2 NM^2) in Rhode Island and Block Island sounds.

3.11.2.3.1.3 Virginia Capes Range Complex

Military Ocean Traffic

The Virginia Capes OPAREA covers approximately 27,661 NM^2 of sea space off the coast of Delaware, Maryland, Virginia, and North Carolina. About 70 surface ships and submarines are homeported in Norfolk, Virginia. The Fleet Forces Atlantic Exercise Coordination Center is responsible for coordinating activities within the OPAREA, and with all DoD, government, and civilian agencies, to ensure compliance with all requirements and regulations for the safe use of range assets and services. The Fleet Area Control and Surveillance Facility, Virginia Capes has authority to coordinate services and firing notices, issue weekly target and OPAREA schedules, and prescribe necessary additional regulations governing matters within the Virginia Capes Range Complex.

Civilian Ocean Traffic

Ships transiting the lower Chesapeake Bay area follow two primary commercially used shipping lanes: the Thimble Shoals Channel, which leads to Hampton Roads, Virginia; and the Chesapeake Channel, which leads to points north, including the Port of Baltimore. These two channels pass over the underwater (tunnel) sections of the Chesapeake Bay Bridge-Tunnel system, which connects the City of Virginia Beach to Cape Charles on the Eastern Shore. The Port of Baltimore was ranked 16th in total trade among U.S. ports in 2016, with over 38 million tons of goods passing through the port (U.S. Army Corps of Engineers, 2017). Over half of the shipments were foreign exports, which would pass through the Chesapeake Bay and into the Virginia Capes OPAREA on their way across the Atlantic Ocean or towards the Panama Canal.

The nearshore areas of the Virginia Capes OPAREA, in particular, are heavily traveled, because of their proximity to commercial ports in both Delaware and Virginia, including the port of Virginia in Norfolk, Virginia, the second-busiest port facility on the U.S. Atlantic coast, and the Port of Wilmington, Delaware, which is located on the Delaware River at the head of the Delaware Bay. In 2016, the Port of Virginia processed 54 million tons of imports and exports, ranking 13th among all U.S. ports and second among East Coast ports in total volume traded (U.S. Army Corps of Engineers, 2017). In 2017, the port handled 1,746 port calls, an average of about five per day and a decrease of near 10 percent over 2016 . Assuming that each port call is associated with two vessel transits (inbound and outbound), nearly 4,000 vessel transits passed from the Port of Virginia (Norfolk) through the lower Chesapeake Bay and into the Virginia Capes OPAREA in 2016. In addition to commercial shipping vessels, commercial ferries operate off the shores of Delaware, Maryland, Virginia, and North Carolina.

Recreational transportation activities offshore consist of game and sport fishing, charter boat fishing, sport diving, dolphin and whale watching, sailing, and power cruising. Approximately, 11.8 million recreational vessels were registered in the United States in 2016; over 90 percent are under 26 ft. and 42 percent are under 16 ft. in length, suggesting that most of these vessels are unlikely to travel far from shore for extended periods of time. The five coastal states from Virginia to Florida maintained 2.3 million registered recreational vessels in 2016, approximately 20 percent of all recreational vessels registered in the United States (U.S. Coast Guard, 2017).

3.11.2.3.1.4 Pierside Locations (mid-Atlantic area)

Military Pierside Locations

Eight pierside locations in the mid-Atlantic area are considered in this Final EIS/OEIS. The pierside locations are the Navy-contractor shipyard in Bath, Maine; Portsmouth Naval Shipyard in Kittery, Maine; the Navy-contractor shipyard and the Naval Submarine Base in Groton, Connecticut; the Navy-contractor shipyard in Newport News, Virginia; Naval Station Norfolk, Norfolk, Virginia; Joint Expeditionary Base Little Creek-Fort Story, Virginia Beach, Virginia; and Norfolk Naval Shipyard, Portsmouth, Virginia.

The shipyard in Bath, Maine is on the Kennebec River approximately 12 mi. above the mouth of the river in southern Maine. There is little waterborne traffic to Bath except barge traffic to the shipyard and vessels bound for repairs. Some fish carriers travel to a cannery north of Bath (Marine World Database, 2009). The U.S. Coast Guard established a 150-yard radius safety zone around the dry dock associated with the contractor facility. The safety radius is only activated when the dry dock is deployed in its dredged basin hole near the center of the Kennebec River.

The Portsmouth Naval Shipyard in Kittery, Maine is on Seavey Island in Portsmouth Harbor on the Piscataqua River. The Port of Portsmouth, located across the Piscataqua River in New Hampshire, is ranked 103rd among U.S. ports in total trade, but 48th in foreign imports, bringing in nearly 2 million tons of imported goods in 2016 (U.S. Army Corps of Engineers, 2017). The port received 96 port calls in 2015, including 65 from tankers transporting petroleum fuels and oils, and 21 from bulk carriers, which transport cargo such as gypsum, salt, and asphalt (U.S. Maritime Administration, 2016). The primary mission of the Portsmouth Naval Shipyard is the overhaul, repair, and modernization of Los Angeles class-submarines. Military ocean traffic is composed of submarines entering and leaving the facility for maintenance.

The Navy-contractor shipyard and the Naval Submarine Base New London in Groton, Connecticut, are on the Thames River, a short river and tidal estuary stretching 15 mi. and emptying in the New London Harbor and Long Island Sound. Military ocean traffic is from vessels traveling to and from the shipyard and the Naval Submarine Base. The U.S. Coast Guard operates a cutter and miscellaneous small craft in the Thames River and New London Harbor. Recreational boating, fishing vessels, and ferry services also use the Thames River. Hess Oil operates a privately owned dock that supports oil and chemical barges.

The Navy-contractor shipyard in Newport News, Virginia, designs, builds, and refuels the U.S. Navy's nuclear-powered aircraft carriers and is one of two facilities within the United States that design and build nuclear-powered submarines. The shipyard is situated along 2 mi. of the James River, a tributary of the Chesapeake Bay.

Naval Station Norfolk, the largest naval complex in the world, supports the operational readiness of the U.S. Atlantic Fleet. Situated at the mouth of the Chesapeake Bay, this naval station is homeport to more than 70 surface and subsurface vessels. Joint Expeditionary Base Little Creek–Fort Story is used as a cantonment area and for outdoor training; it is also at the mouth of the Chesapeake Bay, 7 mi. east of Naval Station Norfolk. Joint Expeditionary Base West (Little Creek) is homeport to a variety of surface vessels. The Norfolk Naval Shipyard, situated along the Elizabeth River, is one of the largest shipyards in the world. It has the ability to overhaul and repair any ship in the U.S. Fleet. The shipyard also repairs, overhauls, and modernizes various submarine classes.

Civilian Pierside Locations

The Port of Virginia operates the Norfolk International Terminals, Portsmouth Marine Terminal, and Newport News Marine Terminal. In 2017, the Port of Virginia had 1,746 ship calls, transported 2.8 million container units, and moved 22 million short tons of cargo.

3.11.2.3.1.5 Navy Cherry Point Range Complex

Military Ocean Traffic

The Navy Cherry Point OPAREA sea space covers 18,617 NM² off the east coasts of North Carolina and South Carolina. The Fleet Forces Exercise Atlantic Coordination Center is responsible for coordinating training OPAREA assignments, ranges, airspace, mobile sea range assets, fixed and mobile targets, Large Area Tracking Range, and electronic attack. The Fleet Forces Atlantic Exercise Coordination Center coordinates with all DoD, government, and civilian agencies to ensure compliance with all requirements and regulations for the safe use of ranges, assets, and services. The Fleet Area Control and Surveillance Facility, Virginia Capes has authority to coordinate services and firing notices, issue weekly target and

OPAREA schedules, and prescribe necessary additional regulations governing matters within the Navy Cherry Point Range Complex.

Civilian Ocean Traffic

The southeast coast of the United States is heavily traveled by marine vessels, with several commercial ports near U.S. Navy OPAREAs like Wilmington, North Carolina; Charleston, South Carolina; Savannah, Georgia; and Jacksonville, Florida. Recreational vessels range throughout the coastal waters, depending on season and weather conditions. North Carolina had over 367,000 registered recreational vessels in 2016, which ranked as the fourth highest total among Atlantic coast states (U.S. Coast Guard, 2017). There are over 200 free water access areas in North Carolina coast, the majority of which are located along or near the coastline (North Carolina Wildlife Resources Commission, 2016).

Travel between the most popular cruising destinations in the area does not require traversing OPAREAs; however, larger recreational vessels, in particular sailboats and motor cruisers in the 50 ft. and larger class, can travel considerable distances offshore and are capable of entering offshore OPAREAs.

Recreational dive vessels travel to shipwrecks that provide habitat suitable for development of artificial reefs and are popular destinations for divers. Divers frequent the Cape Hatteras offshore area because of its volume of artificial reefs provided by shipwrecks (Dive Hatteras, 2003). Billed as the "Graveyard of the Atlantic," the waters of North Carolina, especially Cape Lookout, Cape Fear, Cape Hatteras, and Oregon Inlet, offer many opportunities for wreck diving (Thomas, 2011). For information on shipwrecks within the OPAREAs, see Section 3.10 (Cultural Resources).

The Monitor National Marine Sanctuary is a dive site approximately 16 mi. south-southeast of Cape Hatteras, North Carolina. This sanctuary was established in 1975 to protect the remains of the U.S.S. Monitor. Maritime archaeological expeditions are conducted in the summer, and public diving at this site is available by permit. Waters surrounding the sanctuary are known to contain thousands of other shipwrecks (National Oceanic and Atmospheric Administration, 2015a).

3.11.2.3.1.6 Jacksonville Range Complex

Military Ocean Traffic

The Jacksonville and Charleston OPAREAs, within the Jacksonville Range Complex, cover 50,000 NM^2 of sea space off the coasts of North Carolina, South Carolina, Georgia, and Florida. The Fleet Forces Atlantic Exercise Coordination Center is responsible for coordinating training OPAREA assignments, ranges, airspace, mobile sea range assets, fixed and mobile targets, the Large Area Tracking Range system, and electronic attack. The Fleet Forces Atlantic Exercise Coordination Center coordinates with all DoD, government, and civilian agencies to ensure compliance with all requirements and regulations for the safe use of ranges, assets, and services. The Fleet Area Control and Surveillance Facility, Jacksonville has authority to coordinate services and firing notices, issue weekly target and OPAREA schedules, and prescribe necessary additional regulations governing matters within the Jacksonville Range Complex.

Civilian Ocean Traffic

The nearshore areas of the Jacksonville Range Complex, near the Jacksonville commercial port in particular, are heavily traveled. Recreational activities consist primarily of motor boating, game and sport fishing, jet skiing, waterskiing, shrimping, sailing, sport diving, and bird and whale watching. Recreational boats range throughout the coastal waters, depending on season and weather conditions. A commercial ferry crosses the St. Johns River between Mayport, Florida, and Fort George Island, Florida.

Popular sport diving sites within the range complex consist of natural and artificial reefs. Off the South Carolina coast, these include shipwrecks (with about 30 wrecks in the Charleston OPAREA), as well as artificial and natural reefs. Popular shipwreck and submerged artificial reefs can be found at various depths from 13 to over 30 meters (m), both close to shore and at farther distances (Coastal Scuba, 2007). One of the most popular dive sites off the Georgia coast is Gray's Reef. The area is one of the largest nearshore live-bottom reefs of the southeastern United States (National Oceanic and Atmospheric Administration, 2015b). The associated Gray's Reef National Marine Sanctuary, which is used little by divers because of depth, strong currents, and frequent high levels of turbidity, is 16 mi. off Sapelo Island, Georgia, and encompasses 22 NM² of live-bottom habitat. Divers who do venture out to the sanctuary can access the reef from numerous facilities between Savannah and Brunswick, Georgia (National Oceanic and Atmospheric Administration, 2014).

3.11.2.3.1.7 South Florida Ocean Measurement Facility Testing Range

The Naval Surface Warfare Center Carderock Division, South Florida Ocean Measurement Facility operates an offshore testing area in support of various Navy and non-Navy programs. The South Florida Ocean Measurement Facility Testing Range is adjacent to the Port Everglades entrance channel in Fort Lauderdale, Florida. This test area includes an extensive cable field within a restricted anchorage area, as well as two designated submarine OPAREAs.

The South Florida Ocean Measurement Facility Testing Range does not include identified Special Use Airspace. The airspace adjacent to South Florida Ocean Measurement Facility Testing Range is managed by the Fort Lauderdale International Airport. Air operations at the South Florida Ocean Measurement Facility Testing Range are coordinated with Fort Lauderdale International Airport by the air units involved in the test events.

3.11.2.3.1.8 Key West Range Complex

Military Ocean Traffic

The Key West OPAREA is 8,288 NM² of offshore surface and subsurface area south of Key West, Florida within the Straits of Florida between the United States and Cuba. Because the Key West Range Complex is offshore of mainland areas, air and boat travel are possible within the range complex. Commander, Submarine Force, U.S. Atlantic Fleet, is the Submarine Operations Control Authority for the Eastern Seaboard and, as such, controls all water-space management and prevention of mutual interference for subsurface activities in the Key West Range Complex (U.S. Department of the Navy, 2013). Units are required to obtain clearance for all hazardous or exclusive activities within the OPAREA from the Commanding Officer, Naval Air Station Key West.

Within the Key West OPAREA and warning areas, all units conducting firing or other hazardous activity must comply with Section 8, Chapter 1 of the U.S. Atlantic Fleet Instruction Manual 3120.26 and all Fleet Exercise Publications. Officers in charge of exercises are not permitted to fire munitions or jettison aerial targets unless the area is confirmed to be clear of non-participating civilian and military units (U.S. Department of the Navy, 2013). Naval Air Station Key West would coordinate with the U.S. Coast Guard on issuing Notices to Mariners and with the Federal Aviation Administration on issuing Notices to Airmen, as applicable.

Civilian Ocean Traffic

Commercial and recreational boat traffic is common throughout the Florida Keys and the Gulf of Mexico. Cruise ships have regular routes in the area, and commercial fishing boats use this area frequently.

Commercial ferries cross the Florida Straits between Key West, Florida, and Dry Tortugas National Park, Florida. Additionally, dive and tourist boats cruise the waters and take visitors to the Dry Tortugas National Park.

Large cargo ships, including tankers and dry cargo carriers, cruise ships, fishing vessels, recreational vessels, and research vessels, operate in the Straits of Florida. Most of the cargo and cruise ships are foreign-flagged vessels, while the majority of recreational, fishing, and research vessels are domestic. Historically, the Straits of Florida have been the access route for all ships entering the Gulf of Mexico and those transiting from the north and east to the Panama Canal, making the Florida Straits one of the most heavily trafficked areas in the world (Roberts, 2007). According to the International Maritime Organization, approximately 8,000 large cargo ships and several hundred cruise ships transit the area on an annual basis (International Maritime Organization, 2016).

In 2002, the Florida Keys National Marine Sanctuary and surrounding waters were designated a Particularly Sensitive Sea Area under the International Maritime Organization (International Maritime Organization, 2016). As a result of this designation, some restrictions have been imposed on commercial maritime transit through the Straits of Florida. Commercial maritime vessels may be required to transit farther out to sea and within the boundaries of the Key West Range Complex.

3.11.2.3.1.9 Pierside Locations (Southeast Atlantic Area)

Three pierside locations in the southeast Atlantic area are considered in this EIS/OEIS: Naval Submarine Base Kings Bay, Kings Bay, Georgia; Naval Station Mayport, Jacksonville, Florida; and Port Canaveral, Port Canaveral, Florida.

Located near the mouth of the St. Mary's River in Cumberland Sound, Naval Submarine Base Kings Bay is the east coast home to the Trident nuclear power submarines. Kings Bay is approximately 30 mi. from both the Port of Brunswick, Georgia, and the Port of Jacksonville, Florida. Traffic in the Cumberland Sound is primarily recreational boats, and some of the marine traffic in the area is submarine traffic to and from the Naval Submarine Base Kings Bay.

Naval Station Mayport is located where the St. Johns River meets the Atlantic Ocean. This facility is home to 22 U.S. Navy ships and can accommodate 34 ships in its harbor. The St. Johns River supports heavy recreational and commercial traffic, and it provides the Port of Jacksonville access to the Atlantic Ocean. Cruise lines offer passenger cruise service from the Port of Jacksonville to the Caribbean.

Port Canaveral is the second-busiest port in the world for multiday passenger cruises, with six terminals exclusively for cruise passenger use (Port Canaveral, 2016). In 2016, Port Canaveral had 1,388 cruise ship port calls and serviced nearly 4 million passengers (American Association of Port Authorities, 2017b). In 2015, Port Canaveral was ranked 91st in total trade, with 3.1 million tons passing through the port, and 44th in foreign trade imports (U.S. Army Corps of Engineers, 2016). The port is shared with the Navy, which uses Trident Wharf and Poseidon Wharf to service U.S. Navy submarines.

3.11.2.3.1.10 Naval Surface Warfare Center, Panama City Division Testing Range

The Naval Surface Warfare Center, Panama City Division Testing Range is located off the panhandle of Florida and Alabama, extending from the shoreline to 120 NM seaward, and includes St. Andrew Bay. Special Use Airspace associated with Naval Surface Warfare Center, Panama City Division Testing Range includes warning areas overlying and east of the Pensacola and the Panama City OPAREAs. The warning areas include W-151, W-155, and W-470. This testing range includes the sea space within the Gulf of Mexico from the mean high tide line to 120 NM offshore.

3.11.2.3.1.11 Gulf of Mexico Range Complex

Military Ocean Traffic

The OPAREAs associated with the Gulf of Mexico Range Complex, including the Panama City, Pensacola, New Orleans, and Corpus Christi OPAREAs, cover approximately 17,000 NM^2 of sea space offshore of Florida, Alabama, Mississippi, Louisiana, and Texas. The Fleet Forces Atlantic Exercise Coordination Center is responsible for coordinating training OPAREA assignments, ranges, airspace, mobile sea range assets, fixed and mobile targets, Large Area Tracking Range, and electronic attack. The Fleet Forces Atlantic Exercise Coordination Center coordinates with all DoD, government, and civilian agencies to ensure compliance with all requirements and regulations for the safe use of ranges, assets, and services. The Fleet Area Control and Surveillance Facility, Jacksonville has authority to coordinate services and firing notices, issue weekly target and OPAREA schedules, and prescribe necessary additional regulations governing matters within the Gulf of Mexico Range Complex. The scheduling authority coordinates with the U.S. Coast Guard to issue Notices to Mariners and with the Federal Aviation Administration to issue Notices to Airmen, as applicable. Through close coordination, controlling authorities ensure that hazardous activities are carefully scheduled to avoid conflicts with civilian activities and that safety standards are maintained while allowing the maximum amount of civilian access to airspace and sea space. The Navy does not conduct as much vessel training in the Gulf of Mexico Range Complex as it does in other range complexes in the Study Area. Refer to Table 2.6-1 in Chapter 2 (Description of Proposed Action and Alternatives) for numbers of training activities expected to occur in the Gulf of Mexico Range Complex annually.

Civilian Ocean Traffic

The Gulf of Mexico is heavily traveled by marine vessels, with several major commercial shipping ports located near U.S. Navy OPAREAs, including the ports of South Louisiana; New Orleans, Louisiana; Houston, Texas; and Corpus Christi, Texas. The Port of South Louisiana was the top ranked U.S. port by cargo tonnage with near 262 million tons of cargo processed in 2016 (American Association of Port Authorities, 2017a). The Port of Houston was ranked second among U.S. ports with just under 248 million tons of total trade. Overall, 7 of the top 10 U.S. ports ranked by total trade (tonnage) in 2016 are located in Gulf States. In addition to South Louisiana and Houston, the other five ports are New Orleans (fourth); Beaumont, Texas (fifth); Corpus Christi (sixth); Baton Rouge, Louisiana (eighth); and Mobile, Alabama (tenth) (American Association of Port Authorities, 2017a).

Recreational activities offshore consist of game and sport fishing, charter boat fishing, sport diving, sailing, power cruising, and other boating activities. Commercial ferries operate off the shores of Texas (Corpus Christi and Galveston), Louisiana (Cameron), Mississippi (Ship Island and Gulfport), and Alabama (Dauphin Island and Fort Morgan). There are approximately 1.3 million recreational vessels registered in the Gulf States (excluding Florida vessels which were counted with southeast Atlantic states) (U.S. Coast Guard, 2017). The number of vessels is approximately 11 percent of all recreational vessels registered in the United States and is about the same as the number of vessels registered in coastal states from Maine to Maryland. Popular sport diving and fishing sites within the Gulf of Mexico consist of natural and artificial reefs, including shipwrecks. A popular diving destination in the Gulf is the Flower Garden Banks National Marine Sanctuary, which consists of the East and West Flower Garden Banks and Stetson Bank. The three areas in the 42 NM^2 sanctuary are approximately 130 mi. northeast of the Corpus Christi OPAREA and approximately 190 mi. west of the New Orleans OPAREA (National Oceanic and Atmospheric Administration, 2016b).

3.11.2.3.1.12 Pierside Locations (Gulf of Mexico)

One pierside location in the Gulf of Mexico is considered in this Final EIS/OEIS. The Navy-contractor shipyard in Pascagoula, Mississippi, is strategically located where the Pascagoula River flows into the Mississippi Sound. Construction services for surface combatants, amphibious assault and transport, U.S. Coast Guard cutters, and fleet support occur at this shipyard. The Port of Pascagoula, located at the mouth of the Pascagoula River, is the largest seaport in Mississippi. The port handled over 26 million tons of goods in 2016 and is ranked 24th in total trade and 21st in total foreign trade (imports and exports) among U.S. ports (American Association of Port Authorities, 2017a).

3.11.2.3.2 Air Transport

Most of the airspace in the Study Area is accessible to general aviation (recreational, private, corporate) and commercial aircraft; however, like waterways, some areas are temporarily off limits to civilian and commercial use. The Federal Aviation Administration has established Special Use Airspace that refers to airspace of defined dimensions wherein activities must be confined because of their nature or in which limitations may be imposed upon aircraft operations that are not part of those activities (Federal Aviation Administration Order 7400.21). Special Use Airspace in the Study Area includes the following:

- Restricted Area Airspace: Areas where aircraft are subject to restriction due to the existence of unusual (often invisible) hazards to aircraft (e.g., release of munitions). Some areas are under strict control of the DoD, and some are shared with nonmilitary agencies.
- Military Operations Area: Areas typically below 18,000 ft. used to separate or segregate certain nonhazardous military flight activities from instrument flight rules traffic and to identify visual flight rules traffic where these activities are conducted.
- Warning Area: Areas of defined dimensions, extending from 3 NM outward from the coast of the United States that serve to warn non-participating aircraft of potential danger.
- Air Traffic Controlled Assigned Airspace: Airspace established by the Federal Aviation Administration for the purpose of providing air traffic segregation between specified activities being conducted within the assigned airspace and other Instrument Flight Rules traffic.

Notices to Airmen are created and transmitted by government agencies and airport operators to alert aircraft pilots of any hazards en route or at a specific location. The Federal Aviation Administration issues Notices to Airmen to disseminate information on upcoming or ongoing military exercises with resulting airspace restrictions. Civilian aircraft operators are responsible for being aware of restricted areas in airspace and any Notices to Airmen in effect. Pilots have a duty to abide by aviation rules as administered by the Federal Aviation Administration.

Fleet Area Control and Surveillance Facility, Virginia Capes and Fleet Area Control and Surveillance Facility, Jacksonville provide instruction for training activities involving military air operations (including Naval Air Systems Command testing activities). Naval Surface Warfare Center, Panama City Division Testing Range and Naval Undersea Warfare Center Division, Newport Testing Range instructions provide guidance for testing activities, including air operations. The Federal Aviation Administration has established Special Use Airspace (Chapter 2, Description of Proposed Action and Alternatives) overlying the Study Area for military activities (i.e., restricted area airspace and warning areas).

The Federal Aviation Administration has established commercial air corridors for commercial traffic. The use of commercial air corridors, along with the use of Notices to Airmen, provides for safe and efficient air traffic control.

3.11.2.4 Commercial and Recreational Fishing

3.11.2.4.1 Commercial Fishing

Commercial and recreational fishing takes place throughout much of the Study Area from waters adjacent to the mainland and offshore islands to offshore banks and deep waters far from land. Many different types of fishing gear are used by commercial and recreational fishers in the Study Area, such as gillnets, longline gear, troll gear, trawls, seines, traps or pots, harpoons, and hook and line (U.S. Department of the Navy, 2005, 2015). Many fishing activities are seasonal and occur at varying degrees of intensity and duration throughout the year.

Commercial and recreational fishing is subject to state and federal regulations and laws. The U.S. Coast Guard enforces regulations of the U.S. commercial fishing fleet. The National Oceanic and Atmospheric Administration's Office of Law Enforcement enforces domestic laws and international treaty requirements designed to ensure global fisheries resources are maintained at healthy levels for the future. As part of that effort, the National Marine Fisheries Service assesses the status of fisheries stocks to assist marine resources managers in maintaining sustainable fisheries as well as healthy ecosystems and productive coastal communities. Fisheries stock assessment reports contain information on the status of the stock, such as the annual and historic catch, and, if a stock is depleted, the steps required to rebuild a healthy stock capable of sustaining commercial and recreational fisheries.

The management of fisheries is conducted on a regional basis to allow participatory governance by knowledgeable people with a stake in fishery management. Eight regional fishery management councils are responsible for developing fishery management plans for the fisheries in their jurisdiction. The plans focus on the status of the fishery in waters seaward of state waters within each region. Each fishery management plan describes a variety of management tools, including geographic and seasonal fishery closures, catch limits and quotas, size and age limits, gear restrictions, and access controls to manage the fishery resources. Nationwide, 44 fishery management plans provide a framework for managing the harvest of 230 major fish stocks or stock complexes that make up 90 percent of the commercial harvest. Other species, designated as highly migratory species in fisheries regulations, such as tunas, swordfish, sharks, and billfish are found throughout the Pacific Ocean and migrate across council jurisdictional boundaries. Regional offices of the National Marine Fisheries Service manage these species and engage stakeholders and governmental groups in the management of these species at both domestic and international levels.

Determining whether a catch is considered a commercial or recreational catch depends on how the catch is used. A catch is considered commercial if sold for profit at the port (e.g., to a processor). While a chartered recreational fishing trip results in a commercial gain for a charter boat captain, the catch is retained by the fisher and is not sold at the port for a profit. Therefore, the catch is considered recreational. Commercial fishers often target more than one species and land their catch in multiple ports, depending on the season, to maximize their economic return. Recreational fishers primarily use hook and line (also referred to as rod and reel or pole and line), and a small number also use spearfishing gear (Southwick Associates, 2013).

The National Marine Fisheries Service Office of Science and Technology maintains commercial landing data derived from comprehensive surveys of all coastal states' landings (National Marine Fisheries Service, 2015c). The number of pounds of fish caught in the U.S. Atlantic region by commercial fishers has been decreasing since a peak in 1956 (Figure 3.11-5), although the total value of fish caught has been steadily increasing since the early 1970s (National Marine Fisheries Service, 2015c). In 2005, the price per pound for all species combined exceeded $1.00 for the first time, but then declined from 2007 through 2009 during the economic recession. Since 2010, the value of the catch has trended upwards (National Marine Fisheries Service, 2015c).

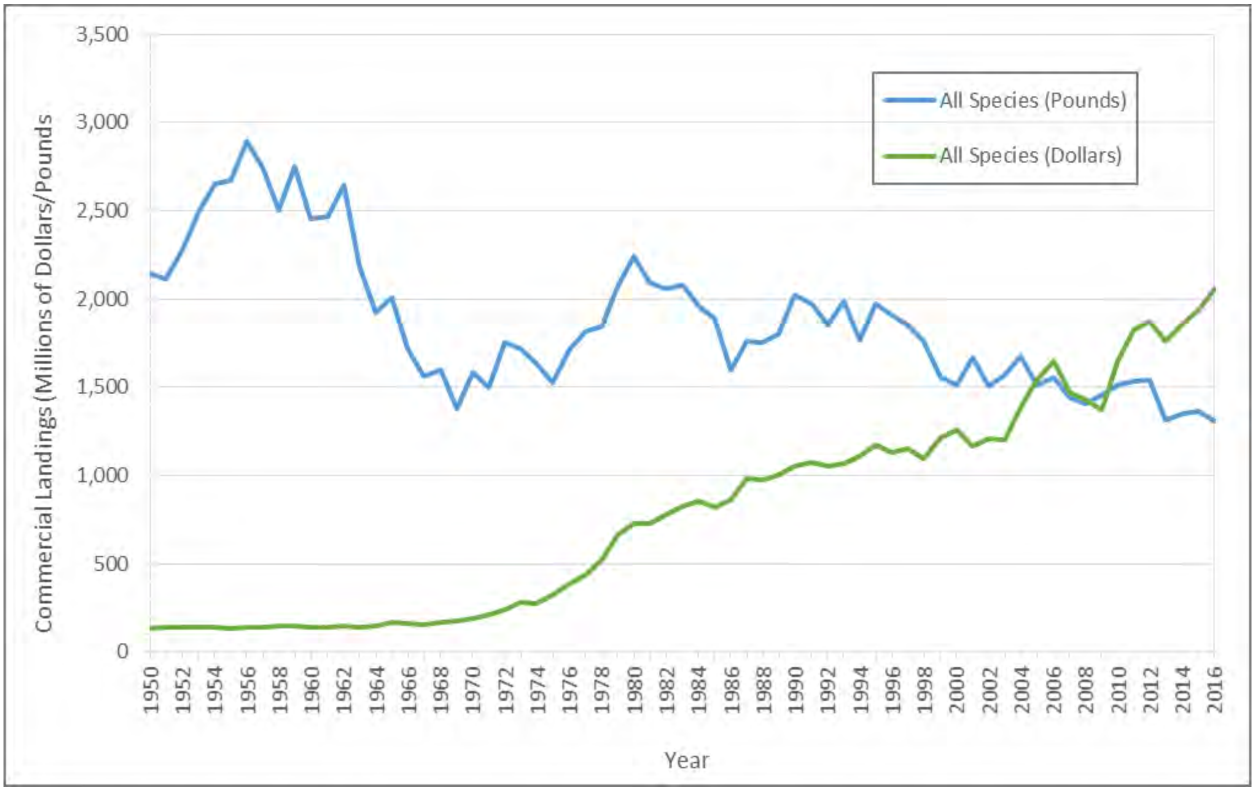


Figure 3.11-5: Commercial Landings Since 1950 in Atlantic Coast States

In the Gulf of Mexico, the highest catch totals (pounds) occurred in the mid-1980s and have gradually declined since (Figure 3.11-6). Similar to the catch in the Atlantic, the value of commercial landings in the Gulf of Mexico increased steadily through the mid-1980s. With the exception of the year 2000, growth remained flat until 2010 and has since trended upwards, with the value of the 2014 catch exceeding $1 billion for the first time (National Marine Fisheries Service, 2015c). However, the value of the catch in 2015 and 2016 fell below $1 billion.

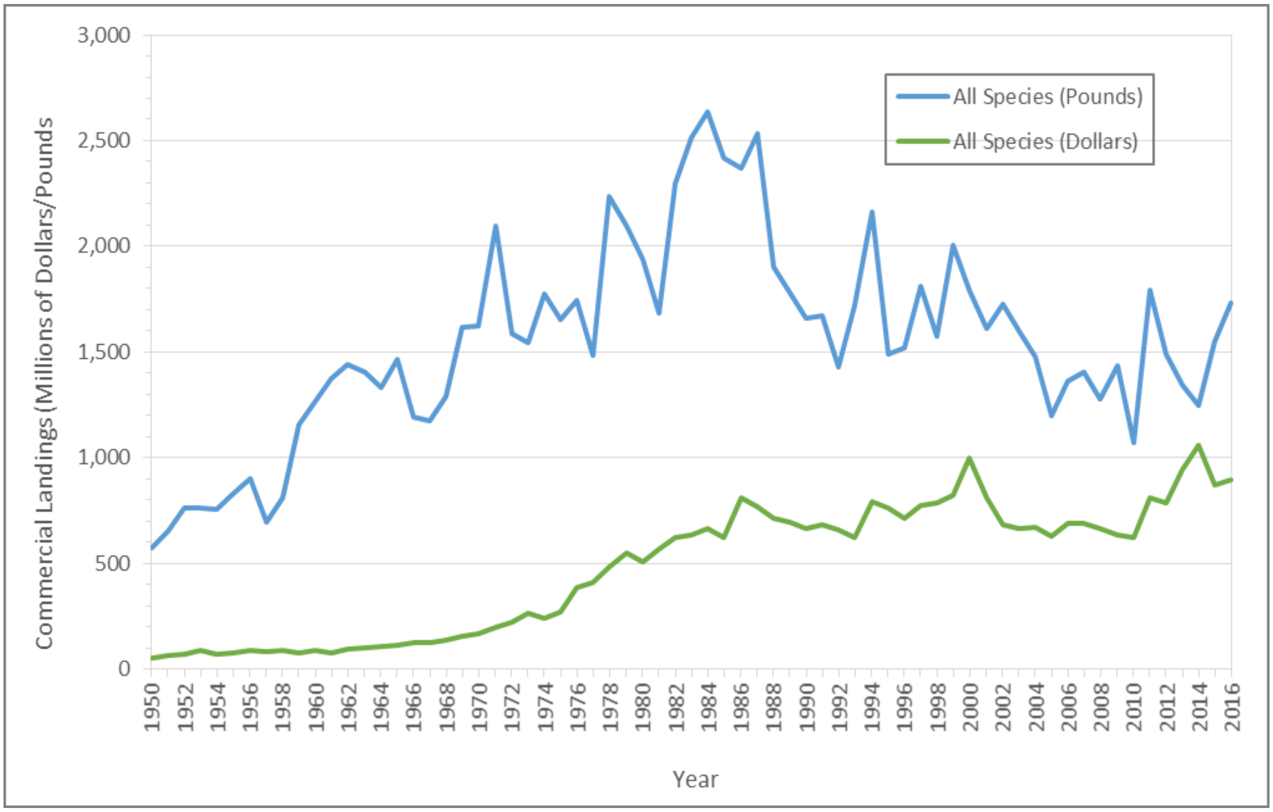


Figure 3.11-6: Commercial Landings Since 1950 in Gulf Coast States

Commercial fishing occurs in federally managed waters (3–200 NM) and within state waters (out to 3 NM; 9 NM for Texas and Florida's west coast). Each state's natural resources or wildlife management department manages fisheries in state waters using an organizational structure similar to the structure used by federal managers. Quotas can be placed on species at the federal or state level to manage landings and sustain the fishery. These may include seasonal closures or gear restrictions specific to a particular fishery. Table 3.11-1 shows the commercial species with the highest value in 2016 for each of the 18 coastal states in the Study Area. American lobster and sea scallops were the two most lucrative species both in the northeast and overall for all 18 coastal states. Combined these two species had a value of over $1 billion in 2016. Off the mid-Atlantic, blue crab is the most valuable species, and along the Atlantic coast from South Carolina to Florida, shrimp are the most valuable catch. In the Gulf of Mexico, over 1 billion pounds of menhaden were landed in Louisiana, and, combined with the total for Mississippi, menhaden were valued at over $140 million in 2016. Of all the species listed in Table 3.11-1, menhaden are the only vertebrate ("fish") species. All other species are invertebrates, and most of those are benthic species (e.g., lobsters and crabs) (National Marine Fisheries Service, 2018a). Additional information on commercially important species is in Sections 3.4 (Invertebrates) and 3.6 (Fishes).

Table 3.11-1: Value of Top Commercial Catch in Atlantic and Gulf States, 2016

State	*Species*	*Catch (Pounds)*	*Value (Dollars)*
Maine	American lobster	132,531,000	540,335,139
New Hampshire	American lobster	5,781,837	30,370,906
Massachusetts	Sea scallop	22,845,729	281,210,347
Rhode Island	Longfin squid	22,508,475	28,423,823

Table 3.11-1: Value of Top Commercial Catch in Atlantic and Gulf States, 2016 (continued)

State	*Species*	*Catch (Pounds)*	*Value (Dollars)*
Connecticut	Sea scallops	530,242	5,880,876
New York	Northern quahog (clam)	2,173,059	11,951,812
New Jersey	Sea scallop	10,491,244	123,369,150
Delaware	Blue crab	4,555,178	9,144,630
Maryland	Blue crab	36,721,568	54,426,092
Virginia	Sea scallop	4,529,495	51,325,283
North Carolina	Blue crab	24,732,129	20,738,465
South Carolina	Marine Shrimp	2,665,916	6,746,504
Georgia	White shrimp	1,998,110	5,284,582
Florida (Atlantic coast)	White shrimp	4,791,846	12,807,638
Florida (Gulf coast)	Caribbean spiny lobster	5,014,422	41,249,030
Alabama	Brown shrimp	12,830,091	32,760,985
Mississippi	Menhaden	294,189,312	10,973,261
Louisiana	Menhaden	1,068,689,545	132,105,452
Texas	Brown shrimp	38,309,340	96,170,706

Source: National Marine Fisheries Service (2018a)

3.11.2.4.2 Recreational Fishing

There were about 11.8 million registered recreational vessels in the United States in 2016. Approximately 42 percent of these vessels are registered in the 18 coastal states within the Study Area (U.S. Coast Guard, 2017). Many of these vessels are used for saltwater sport fishing, which has long been one of America's most popular recreational activities. Recreational fishing also influences the economies in many coastal communities by providing jobs, income, and sales. In 2015, approximately 9 million recreational anglers across the United States took 61 million saltwater fishing trips around the country. Approximately 90 percent of these recreational angler trips were off the U.S. Atlantic (56 percent) and Gulf (34 percent) coasts (National Marine Fisheries Service, 2016a). In 2015, 55 percent of the recreational catch (measured by numbers of fish) was taken from inland waters. Almost 35 percent came from state waters and just over 10 percent of the catch came from the U.S. territorial sea out to the Exclusive Economic Zone. The majority of trips in the Atlantic and Gulf of Mexico fished primarily in inland waters (i.e., estuaries) (National Marine Fisheries Service, 2016a).

Favored fishing areas change over time with fluctuations in fish populations and communities, preferred target species, or fishing modes and styles. Popular fishing sites are characterized by relative ease of access, ability to anchor or secure the boat, and abundant presence of target fish. Fishers focusing on areas of bottom relief not only catch reef-associated fish but also coastal open water species that may be attracted to the habitat. Popular fishing areas and dive sites are located throughout the coastal and nearshore waters of the Study Area and generally decrease in number with increasing distance from shore. Numerous fishing and diving sites are located along the Atlantic and Gulf coasts, in every state boarding the Study Area and in Puerto Rico and the U.S. Virgin Islands.

From 2012 through 2017, the marine recreational catch (total number of fish harvested + total released) in the Study Area ranged from a low of 301 million in 2017 to a peak of 413 million in 2013 (Figure 3.11-7). On average, over 60 percent of the catch is released each year. The catch has been trending downward since 2013, and the number of fish harvested has declined each year since 2013.

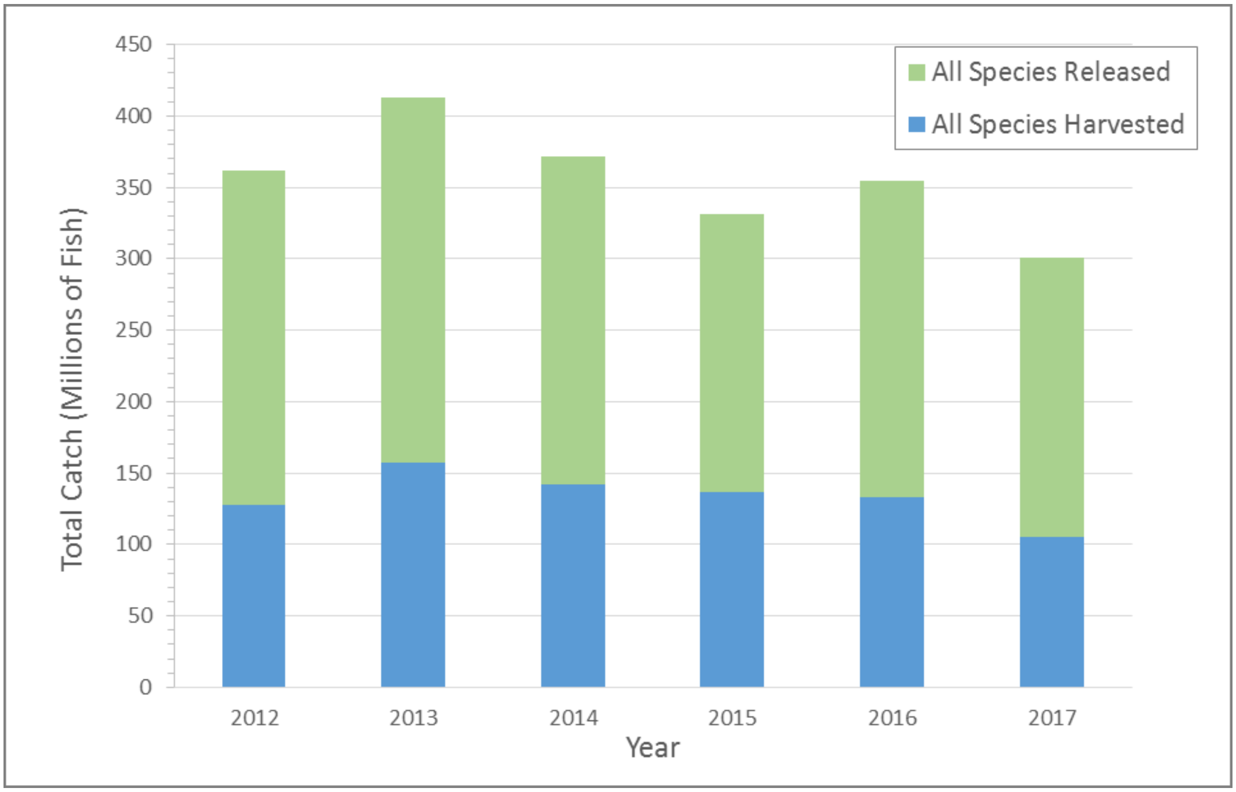


Figure 3.11-7: Annual Recreational Catch of All Species for the 18 Coastal States (2012–2017)

The top five recreational species, measured by the total catch, in the Atlantic states between 2012 and 2017 were black sea bass, summer flounder, Atlantic croaker, bluefish, and striped bass (National Marine Fisheries Service, 2018b) (Figure 3.11-8). Catch totals for Florida are included with the Gulf States; separate catch totals for Florida's east and west coasts were not provided in National Marine Fisheries Service (2017). The species most commonly caught on Atlantic coast trips that fished primarily in federally managed waters (3 to 200 NM) were black sea bass, summer flounder, haddock, Atlantic cod, and Atlantic mackerel (National Marine Fisheries Service, 2017). Data on the total catch from only federal waters are not available; however, measured by the number of fish caught in all waters off the Atlantic coast in 2016, black sea bass ranked first (16.7 million fish), summer flounder second (14.2 million), Atlantic mackerel seventh (6.5 million), haddock ranked 20th (1.7 million fish), and Atlantic cod 25th (1.2 million fish) (National Marine Fisheries Service, 2018b). Three of the top 10 species most frequently caught in federal waters are among the most frequently caught species overall.

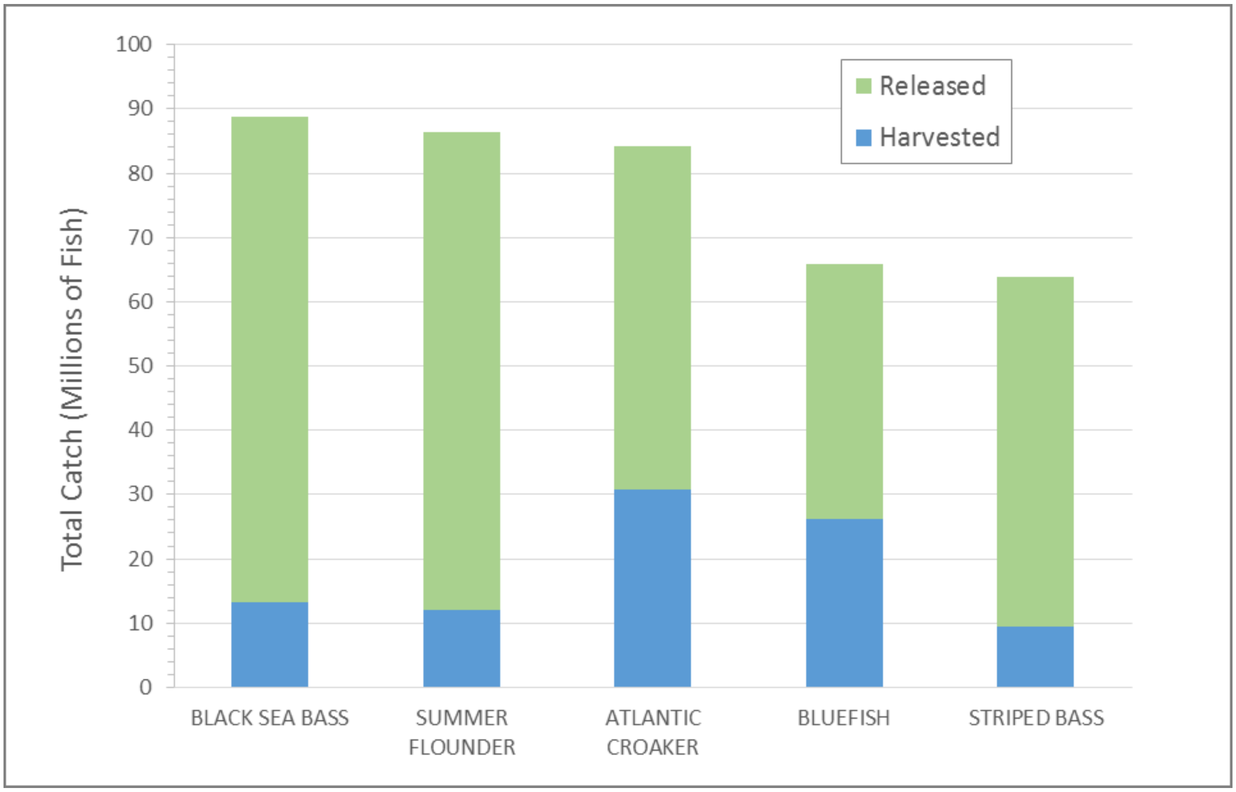


Figure 3.11-8: Top Five Recreational Species Caught in the Atlantic States (2012–2017)

The top five recreational species, measured by the number of fish caught, in the Gulf states between 2012 and 2017 were spotted seatrout, scaled sardine, pinfish, gray snapper, and hardhead catfish (National Marine Fisheries Service, 2018b) (Figure 3.11-9). Excluding bait fishes, the species most commonly caught in the Gulf of Mexico were spotted seatrout, gray snapper, hardhead catfish, red drum, and red snapper. The species most commonly caught on trips that fished primarily in federally managed waters were red snapper, white grunt, red grouper, black seabass, and gray triggerfish (National Marine Fisheries Service, 2017). Data on the total catch from only federal waters are not available; however, measured by the number of fish caught in all waters in the Gulf of Mexico in 2016, red snapper ranked eighth (4.9 million), white grunt ranked 16th (3.7 million fish), black seabass ranked 23rd (2.2 million), gray triggerfish ranked 25th (1.9 million), and red grouper ranked 30th (1.4 million) (National Marine Fisheries Service, 2018b). Only one species, red snapper, is among the top 10 species caught by recreational fishers in the Gulf of Mexico.

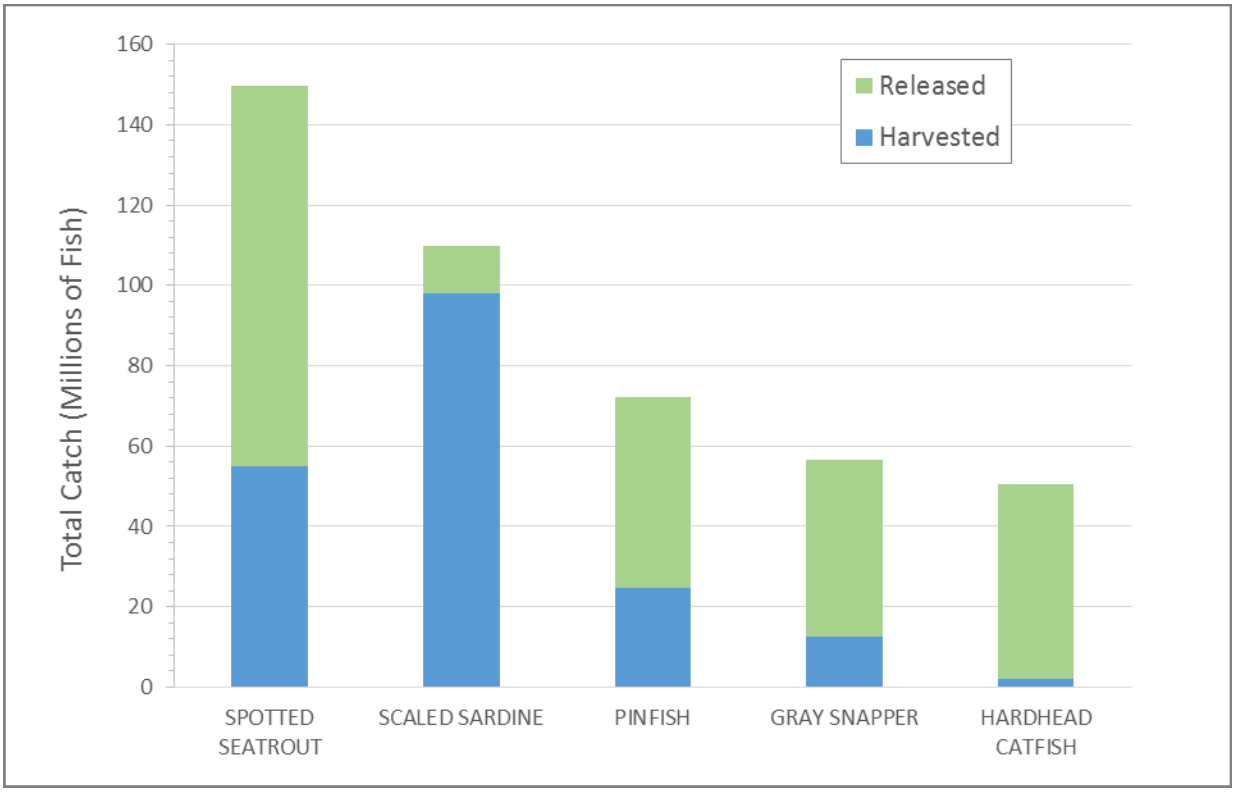


Figure 3.11-9: Top Five Recreational Species Caught in the Gulf States (2012–2017)

Recreational fishing is a popular pastime in coastal areas of both the Atlantic Ocean and Gulf of Mexico. In 2015, more than 65.21 million residents of Atlantic coast states participated in marine recreational fishing. All participants, including visitors, took nearly 34 million trips and caught approximately 188 million fish. About 25 percent of the trips were made off Florida's Atlantic coast, 14 percent off North Carolina, almost 13 percent off New Jersey, almost 10 percent off New York, nearly 8 percent off South Carolina shores, nearly 7 percent off Maryland, and more than 6 percent off Massachusetts. Together, Rhode Island, Connecticut, and Virginia, accounted for 13 percent of the trips, and Maine, New Hampshire, Delaware, and Georgia accounted for the remaining 4 percent of trips (National Marine Fisheries Service, 2016a).

In the Gulf of Mexico in 2015, nearly 2.7 million residents of Gulf Coast states participated in marine recreational fishing. All participants, including visitors, took 21 million trips and caught almost 143 million fish. About 65 percent of the trips were made off Florida's Gulf coast, nearly 12 percent off Louisiana, 11 percent off Alabama, more than 7 percent off Mississippi, and approximately 5 percent off Texas shores (National Marine Fisheries Service, 2016a).

As reported above, approximately 10 percent of the recreational fishing catch is from federal waters (i.e., between 3 and 200 NM from shore) (National Marine Fisheries Service, 2016a). However, this approximation, based on the total number of fish caught, can vary considerably depending on the species targeted. For the top five species caught off the Atlantic and Gulf coasts in 2016, the percentage caught in federal waters (nationally, not just in the Study Area) ranged from 0.01 percent for spotted seatrout to 15 percent for pinfish (Figure 3.11-10, Figure 3.11-11). Only 1 of the 10 top species caught in the Study Area exceeded the 10 percent national average in 2016 for the number of fish caught in federal waters (pinfish off the Gulf coast).

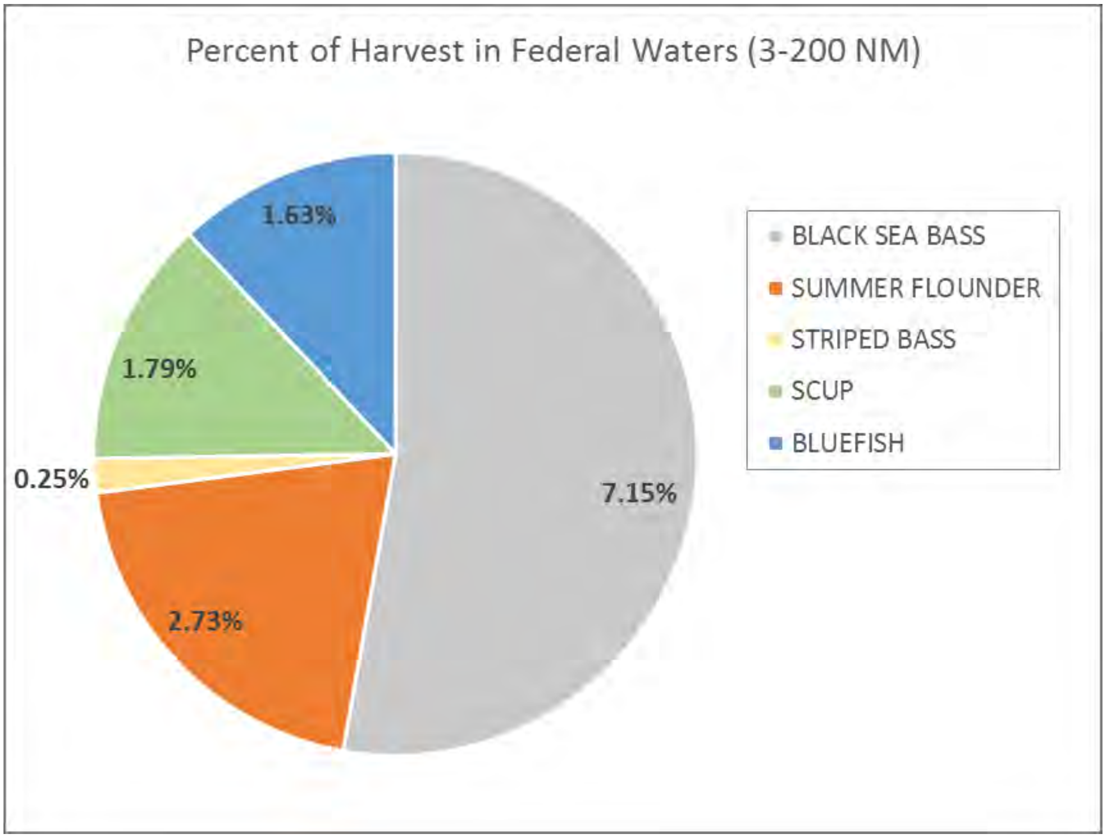


Figure 3.11-10: Percent of Harvest in Federal Waters for Top Five Atlantic Coast Recreational Species (Measured By Number of Fish Caught) in 2016

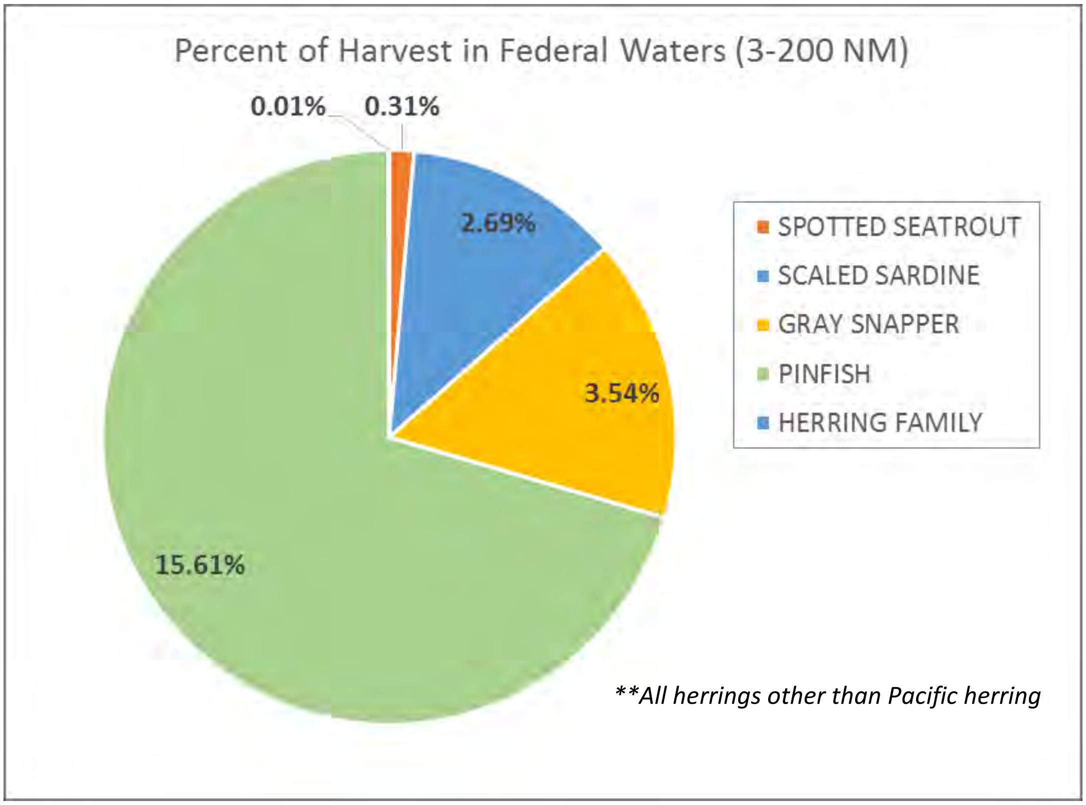


Figure 3.11-11: Percent of Harvest in Federal Waters for Top Five Gulf Coast Recreational Species (Measured By Number of Fish Caught) in 2016

The contribution of recreational fishing activities to the economy of coastal states is measured by state level impacts, including jobs, sales, income, and value added to the economy from expenditures on fishing trips and durable equipment. The economic impacts of recreational fishing for the five New England coastal states (Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut) are summarized in Table 3.11-2. The latest data available are from 2014.

Table 3.11-2: Economic Benefit of Recreational Fishing Expenditures in the Northeast in 2014

Economic Factor	*State*				
	ME	*NH*	*MA*	*RI*	*CT*
Number of Recreational Fishing Trips (thousands)	539	252	3,397	1,099	1,364
Jobs Supported by Recreational Fishing	1,051	563	14,264	4,439	2,993
Sales (millions of dollars)	85	53	1,391	421	290
Income (millions of dollars)	36	25	688	199	138
Value-Added (millions of dollars)	56	35	996	301	216

Source: (National Marine Fisheries Service, 2016b)

Massachusetts receives the greatest economic benefit from recreational fishing in the New England region, followed by Rhode Island. New Hampshire benefits from recreational fishing the least, likely due to its relatively small expanse of coastline.

The economic impacts of recreational fishing for the six Mid-Atlantic coastal states (New York, New Jersey, Delaware, Maryland, Virginia, and North Carolina) are summarized in Table 3.11-3. The latest data available are from 2014. New Jersey and North Carolina receive the greatest economic benefit from recreational fishing in the Mid-Atlantic region, with over 15,000 jobs and approximately $1 billion added to each state's economy. The economic benefit from recreational fishing to New Jersey's economy is second only to Florida among U.S. coastal states. Delaware has the lowest economic benefit from recreational fishing expenditures in the region.

Table 3.11-3: Economic Benefit of Recreational Fishing Expenditures in the Mid-Atlantic in 2014

Economic Factor	*State*					
	NY	*NJ*	*DE*	*MD*	*VA*	*NC*
Number of Recreational Fishing Trips (thousands)	3,955	4,869	868	2,473	2,182	4,954
Jobs Supported by Recreational Fishing	9,561	19,962	1,562	7,721	5,218	16,007
Sales (millions of dollars)	976	2,037	142	727	474	1,529
Income (millions of dollars)	467	956	62	339	213	636
Value-Added (millions of dollars)	719	1,457	98	513	335	990

Source: (National Marine Fisheries Service, 2016b)

The economic impacts of recreational fishing for the southeast Atlantic coastal states (South Carolina, Georgia, and Florida's Atlantic coast) are summarized in Table 3.11-4. The latest data available are from 2014.

Table 3.11-4: Economic Benefit of Recreational Fishing Expenditures in the Southeast Atlantic in 2014

Economic Factor	*State*		
	SC	*GA*	*FL (Atlantic)*
Number of Recreational Fishing Trips (thousands)	2,221	827	9,644
Jobs Supported by Recreational Fishing	6,224	2,145	44,789
Sales (millions of dollars)	545	190	4,782
Income (millions of dollars)	220	88	2,022
Value-Added (millions of dollars)	344	136	3,122

Source: (National Marine Fisheries Service, 2016b)

As shown in Table 3.11-4, recreational fishing on the Florida's Atlantic coast supports the greatest number of jobs and generates the highest sales value of all the states along the entire U.S. Atlantic coast. Recreational fishing in Monroe County and the City of Key West is a major generator of economic activity and contributes $500 million annually (National Oceanic and Atmospheric Administration, 2005). The diverse fishing opportunities are reflected in an abundance of tournaments offered year round. Fished species include sailfish, bonefish, kingfish, snook, redfish, tarpon, dolphinfish, grouper, snapper, blackfin tuna, marlin, wahoo, and others. Tournaments can take place on the weekends, but many occur during the week (Monroe County Tourist Development Council, 2010).

The economic impacts of recreational fishing for the Gulf States (Florida's Gulf coast, Alabama, Mississippi, Louisiana, and Texas) are summarized in Table 3.11-5. The latest data available are from 2014. Florida's Gulf coast benefits tremendously from recreational fishing, with nearly $16 billion in sales, income, and value added from recreational fishing expenditures. Florida's Gulf coast recreational fishing industry supports more jobs and more trips that any other state bordering the Study Area. Excluding Florida's Atlantic coast, Texas and Louisiana generate the third- and fourth-most sales from expenditures of all U.S. coastal states, respectively.

Table 3.11-5: Economic Benefit of Recreational Fishing Expenditures in the Gulf of Mexico in 2014

Economic Factor	***State***				
	Florida (Gulf)	***AL***	***MS***	***LA***	***TX***
Number of Recreational Fishing Trips (thousands)	15,179	2,169	1,480	2,188	--
Jobs Supported by Recreational Fishing	70,109	14,124	4,174	15,241	16,496
Sales (millions of dollars)	7,468	1,071	374	1,620	1,825
Income (millions of dollars)	3,161	540	158	662	757
Value-Added (millions of dollars)	4,869	828	247	1,029	1,205

Note: (--) Data Not Available
Source: (National Marine Fisheries Service, 2016b)

Various organizations host recreational fishing tournaments throughout the year in the 18 coastal states, although, recreational fishing in the New England and the Mid-Atlantic states occur primarily in summer and into early fall when temperatures are warmer and there are more daylight hours. Most tournaments take place on weekends (Friday through Sunday) or from the middle of the week through the weekend (Wednesday to Sunday). Most fishing takes place at hotspots like canyons and seamounts.

It is unlikely that a substantial amount of recreational fishing occurs on the high seas (greater than 200 NM from shore). The size of a ship capable of safely transiting into the high seas would exceed the size of most recreational vessels registered with the U.S. Coast Guard (U.S. Coast Guard, 2017).

3.11.2.5 Aquaculture

Aquaculture is the farming of aquatic organisms such as fish, shellfish, and plants. Aquaculture operations are often in coastal environments and can be on land with a nearby water source or in bays, estuaries, or marine waters (National Marine Fisheries Service, 2015a). The National Oceanic and Atmospheric Administration regulates offshore marine aquaculture and crafted the National Offshore Aquaculture Act of 2007, which charges National Oceanic and Atmospheric Administration with establishing stringent standards and coordination of offshore efforts with states (Carlowicz, 2007).

The U.S. marine aquaculture industry is relatively small compared with world aquaculture production. In 2013, U.S. aquaculture production totaled 100 million pounds of fish, molluscs, and crustaceans valued at $400 million (National Marine Fisheries Service, 2015b). World aquaculture production generates over $70 billion in annually. Only about one-third of U.S. aquaculture production is marine species. The largest sector of the U.S. marine aquaculture industry is molluscs (oysters, clams, mussels), which accounts for about two-thirds of total U.S. marine aquaculture production. Atlantic salmon is the leading species for marine finfish aquaculture (42 million pounds), while oysters have the highest volume (44 million pounds) for marine shellfish production. Shellfish aquaculture industries can be found in all coastal regions of the United States; the Pacific Coast states produce more shellfish by value ($112 million), while the Gulf coast states produce more by volume (24 million pounds) (National Marine Fisheries Service, 2015b). Current production takes place mainly on land, in ponds, and in coastal waters under state jurisdiction.

Aquaculture has become a fast-growing food industry because of consumer demands. The U.S. Department of Agriculture maintains a database on sales value from aquaculture. In 2013, sales of aquaculture products in the United States accounted for $1.4 billion. The production of molluscs (oysters, mussels, and clams) was 23 percent of the total sales, and fin fish raised as a source of food (e.g., catfish and salmon) accounted for 52 percent of total sales. The 18 coastal states in the Study Area contributed approximately 57 percent of total aquaculture sales in 2013. These data include all aquaculture sales (inland, freshwater, and marine). However, the importance of the industry to the coastal states is evident, and saltwater aquaculture production has been increasing over the past several years, even as freshwater production is declining (U.S. Department of Agriculture, 2014).

Most aquaculture farms within the Study Area are located in state waters. Based on 2013 census data compiled by the U.S. Department of Agriculture (2014), aquaculture operations occur in the 18 states of the Study Area. Florida and Massachusetts have the greatest number of saltwater farms with 169 and 133, respectively.

Massachusetts and New Hampshire conducted aquaculture research projects in offshore federal waters. In 2007, both states received funding for these projects from the National Oceanic and Atmospheric Administration (National Oceanic and Atmospheric Administration, 2007a). The University of New Hampshire’s Atlantic Marine Aquaculture Center was established in 2006 after completion of the Open Ocean Aquaculture Demonstration Project, which in cooperation with the National Oceanic and Atmospheric Administration raised finfish in the open ocean for noncommercial purposes (University of New Hampshire, 2016). The site is located 6 NM off the coast of New Hampshire. Two projects were funded in Massachusetts. The Massachusetts Institute of Technology developed a self-propelled, open-ocean drifter for fish farming. The pilot study attempted to assess the effects of movement of the drifter cage on fish behavior. The second project, conducted by the Marine Biological Laboratory at Woods Hole, worked to condition black sea bass to respond to an acoustic signal when being fed in a controlled, laboratory environment, so that they could be released into an open-ocean environment and recaptured at a later date (National Oceanic and Atmospheric Administration, 2007b). The National Oceanic and Atmospheric Administration continues to fund aquaculture projects in several states along the U.S. Atlantic and Gulf coasts (National Oceanic and Atmospheric Administration, 2016a).

Atlantic salmon are cultivated in coastal waters off the coast of Maine. The 2011 harvest of 24 million pounds contributed revenue of $55 million. Maine also cultivated blue mussels, American and European oysters, Atlantic cod, quahogs, sea scallops, and green sea urchins (Maine Department of Marine Resources, 2012). The dominant industry along the northeastern coastline is shellfish production in estuaries, bays, and wetlands (Morse & Pietrak, 2009). The only estuary that falls in part of the Northeast Range Complexes is Narragansett Bay, on the north side of Rhode Island Sound. Rhode Island cultivates eastern oysters and northern quahogs. About 123 ac. (50 hectares) are leased for aquaculture production (Rice & Leavitt, 2009).

In the mid-Atlantic area, aquaculture is composed of shellfish production in estuaries, bays, and wetlands. In 1980, the lower Chesapeake Bay, near the Virginia Capes Range Complex, accounted for 50 percent of the U.S. oyster harvest. However, in recent years, overharvesting and disease have depleted the oyster beds to less than 1 percent of their peak abundance (Kearney, 2003). States in the area are encouraging shellfish aquaculture to aid in the restoration (Webster et al., 2009). Virginia cultivates eastern oysters and hard clams using bottom cultivation. However, methods of cultivation for the oyster are evolving from the traditional planting on the bottom to a more intensive method using cages, racks, and floats (Murray & Oesterling, 2009). Virginia accounts for 30 percent of eastern oyster aquaculture sales (U.S. Department of Agriculture, 2014).The mine warfare training areas in the Chesapeake Bay are not in the immediate vicinity of shellfish aquaculture.

Aquaculture in the southeast region includes farms for hybrid striped bass, red drum, saltwater shrimp, and eastern oysters. Louisiana accounts for 42 percent of all crustacean (e.g., shrimp and crabs) sold in the country. Combined, Alabama and Mississippi produced 43 percent of food fish sales from aquaculture in 2013 (U.S. Department of Agriculture, 2014).

3.11.2.6 Tourism

Coastal tourism and recreation include the full range of tourism, leisure, and recreationally oriented activities that take place in the coastal zone and the offshore coastal waters. These activities include coastal tourism development (e.g., hotels, resorts, restaurants, food industry, vacation homes, and second homes) and the infrastructure supporting coastal development (e.g., retail businesses, marinas, fishing tackle stores, dive shops, fishing piers, recreational boating harbors, beaches, and recreational fishing facilities). Also included are ecotourism and recreational activities such as recreational boating, cruises, swimming, surfing, snorkeling, diving, and sightseeing (National Oceanic and Atmospheric Administration, 1998).

Tourism is a component of the regional economy of coastal states included in the Study Area. Although there is no comprehensive database for tourism, available data show that tourist activities bring billions of dollars to communities within the coastal states. Benefits from tourism include direct spending as well as indirect benefits from contributions to key business sectors such as food, lodging, arts, culture, and music. The National Ocean Economics Program provides a range of socioeconomic information along the U.S. coast and in coastal waters. The National Ocean Economics Program defines the ocean economy as the economic activity that indirectly or directly uses the ocean as an input. Table 3.11-6 presents ocean economy data by state specific to the tourism and recreation sector for 2014. The table shows the impact of the marine tourism and recreation industry in coastal counties on states' employment and gross domestic product. The impact of tourism and recreation varies widely among the states, from 1 percent of ocean industries in Texas up to 83 percent in New York and South Carolina (New York includes data from the Great Lakes region). For 15 of the 18 coastal states, the tourism and recreation industry accounts for more than half of ocean industry jobs. Texas and Louisiana have the lowest percentage of ocean industry jobs dependent on tourism and recreation. Industries associated with offshore mineral extraction are the largest contributor to employment and gross domestic product in those states (National Ocean Economics Program, 2015b).

The tourist and recreation industry surrounding recreational boating is significant along the coast of the Atlantic Ocean and the Gulf of Mexico. Self-contained underwater breathing apparatus (SCUBA) diving is a popular recreational activity in this area due to the occurrence of numerous reefs and shipwrecks. Typical considerations for recreational self-contained underwater breathing apparatus (SCUBA) divers relevant to all portions of the Study Area are dive depth limitations. Specifically, the Professional Association of Diving Instructors (one of several scuba diving instructional organizations) suggests that certified open-water divers limit their dives to 60 ft. More experienced divers are generally limited to 100 ft. (Professional Association of Diving Instructors, 2011). Many shipwrecks and artificial reefs that are popular diving spots in Florida are at depths ranging from 50 to 90 ft. (Associated Oceans LLC, 2011).

Marine mammal watching, often referred to as whale watching, includes any cetacean species such as dolphins, whales, and porpoises. Tours are conducted by boat, aircraft, or from land. This type of marine tourism includes any of these activities, formal or informal, that possess at least some commercial component whereby consumers view, swim with, or listen to any of these approximately 83 cetacean species (Hoyt, 2001). Cruises for seal watching are also available in Maine (New Harbor), Massachusetts (Cape Cod), and Rhode Island (Newport) and Connecticut (Groton, Stony Creek, and Niantic).

Hoyt conducted the most recent, comprehensive survey of the whale-watching industry (Hoyt, 2001). In the northeast, the industry focuses on the various whales summering in waters off New England. Whale watching occurs in 22 communities in New England. The majority of operations occur within Massachusetts, where 17 operators conduct whale watching out of popular ports such as Gloucester, Provincetown, Boston, Barnstable, and Plymouth. The 25-year focus of whale watching on the Stellwagen Bank area contributed to its popularity and helped establish the Gerry E. Studds Stellwagen Bank National Marine Sanctuary, which sits at the mouth of Massachusetts Bay. In the southeast, concentrations of the whale watching industry are highest in Hilton Head Island, South Carolina; St. Petersburg, Florida; Panama City, Florida; and Jupiter, Florida. Numerous single operators exist in cities extending along the entire west coast of Florida, all the way to Key West. During a comprehensive survey, approximately 4.3 million people participated in the industry, contributing nearly $357 million in sales to operators of whale watching tours (Hoyt, 2001).

Table 3.11-6: Ocean Economy Data for the Tourism and Recreation Sector by State, 2014

State	*Gross Domestic Product: Tourism and Recreation (Dollars)*	*Percent of all Ocean Industries Gross Domestic Product*	*Tourism and Recreation Employment (Number of Jobs)*	*Percent of all Ocean Industries Employment*
Alabama	507,870,525	22	15,138	56
Connecticut	1,519,176,670	36	34,032	72
Delaware	577,779,055	73	17,530	87
Florida	16,822,577,569	66	365,831	84
Georgia	518,405,327	42	14,847	62
Louisiana	1,882,346,306	8	45,116	41
Maine	1,176,551,058	48	29,785	65
Maryland	2,741,572,336	42	64,976	72
Massachusetts	3,078,180,777	51	67,117	79
Mississippi	400,452,144	23	13,221	43
New Hampshire	279,656,760	20	6,931	51
New Jersey	3,117,260,812	40	82,392	68
New York*	18,296,430,382	83	285,525	91
North Carolina	1,076,758,010	60	36,468	88
Rhode Island	1,365,241,796	68	32,967	83
South Carolina	2,645,396,646	83	61,175	90
Texas	1,470,544,931	1	43,584	22
Virginia	1,809,539,194	22	58,669	51

Shows percent of tourism and recreation employment and gross domestic product compared to all other ocean industries: construction, living resources, minerals, ship and boat building, transportation, and tourism and recreation.
*Includes data from counties adjacent to the Great Lakes.
Source: National Ocean Economics Program (2015b)

3.11.3 Environmental Consequences

This section evaluates how and to what degree the activities described in Chapter 2 (Description of Proposed Action and Alternatives) could impact socioeconomic resources of the Study Area. Tables 2.6-1 through 2.6-4 present the baseline and proposed training and testing activity locations for each alternative including the number of events occurring annually and over a five-year period. Each socioeconomic resource stressor is introduced, analyzed by alternative, and analyzed for training and testing activities. Appendix B (Activity Stressor Matrices) shows the stressors that were considered for analysis of socioeconomic resources. The stressors vary in intensity, frequency, duration, and location within the Study Area. The primary stressors applicable to socioeconomic resources in the Study Area and that are analyzed include the following:

- **Accessibility** (availability of access on the ocean and in the air)
- **Airborne acoustics** (weapons firing, aircraft, and vessel noise)
- **Physical disturbance and strikes** (aircraft, vessels and in-water devices, military expended materials)

Secondary stressors resulting in indirect impacts on socioeconomic resources are discussed in Section 3.11.4 (Secondary Stressors). This section evaluates the impacts of the alternatives on the economy of the region of influence as well as social impacts. The evaluation addresses how the action alters the way individuals live, work, play, relate to one another, and function as members of society. Because proposed AFTT activities are predominantly offshore, socioeconomic impacts would be associated with economic activity, employment, income, and social conditions (i.e., enjoyment and quality of life) of industries or operations that use the ocean resources within the Study Area. Although there are no permanent population centers in the region of influence and the typical socioeconomic considerations such as population, housing, and employment are not applicable, this section will analyze the potential for economic impacts on marine-based activities and coastal communities. When considering impacts on recreational activities such as fishing, boating, and tourism, both the economic impact associated with revenue from recreational tourism and public enjoyment of recreational activities are considered.

The proposed AFTT training and testing activities were evaluated to identify specific components that could act as stressors by directly or indirectly affecting sources of energy generation, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, aquaculture, and tourism. For each stressor, a discussion of impacts on these sources is included for each alternative. The analysis includes consideration of mitigations that the Navy will implement to the benefit of high-value socioeconomic resources in the Study Area.

The evaluation indicated that the relative potential for socioeconomic impacts would be similar across various areas and marine ecosystems in the Study Area. Therefore, the analysis of environmental consequences was not broken down by large marine ecosystem. Based on an initial screening of potential impacts of sonar maintenance and testing, pierside locations have been eliminated from detailed consideration in the analysis of impacts on energy, mineral extraction, and transportation and shipping. Elimination of these resources was based on the extremely limited potential for active sonar to damage infrastructure or interfere with transportation operations.

3.11.3.1 Impacts on Accessibility

Navy training and testing activities have the potential to temporarily change access to the ocean or airspace for a variety of human activities associated with sources of energy generation, mineral extraction, commercial transportation and shipping, commercial and recreational and fishing, aquaculture, tourism, and other recreational activities in the Study Area. Warning Areas, Restricted Areas, and Danger Zones are designated along the Atlantic and Gulf coasts. These designated areas are shown in Figure 3.11-12 through Figure 3.11-15. These small areas may be used for especially hazardous activities and are defined to prohibit or limit public access to the area. They generally provide security or protection for the public from risks of damage or injury arising from activities occurring in that area. Danger zones and restricted areas listed in the CFR and presented by section number in Figure 3.11-12 through Figure 3.11-15 may be closed to the public full time or intermittently, as stated in the regulations (33 CFR section 334).

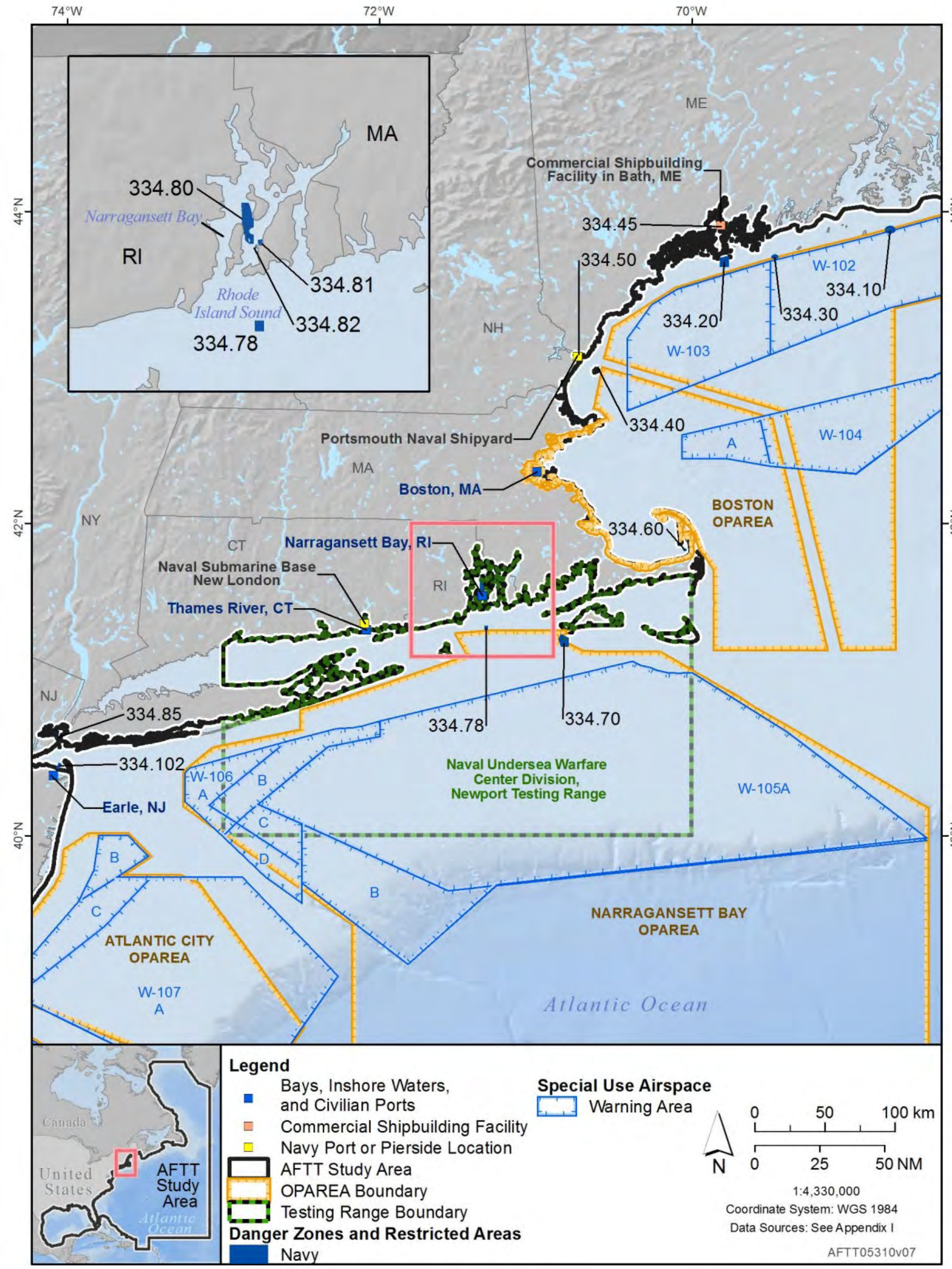
When training or testing activities are scheduled that require specific areas to be free of non-participating vessels and aircraft due to public safety concerns, the Navy requests that the U.S. Coast Guard and Federal Aviation Administration issue Notices to Mariners and Notices to Airmen, respectively, to warn the public of upcoming Navy activities. Many training and testing activities occur in established restricted areas or danger zones as published on navigational and aeronautical charts. Some frequently used areas have standing Notices to Mariners and Notices to Airmen to allow real-time, immediate use.

Limits on accessibility to certain areas of the Study Area due to Navy training and testing would essentially remain unchanged from the current conditions. If access by the public to an area is hindered to the extent that equipment (e.g., fishing gear) cannot be monitored or used, then there would be an impact if this condition would directly contribute to loss of income, revenue, or employment. Disturbance to human activities associated with payrolls, revenue, or employment is quantified by the amount of time the activity may be halted or rerouted and the ability to perform the task in another location.

The Navy is not proposing to add any new restricted areas and proposes to continue the same type of temporary area closures that have occurred for decades. Many of the restricted areas identified on these figures are artifacts of past military activities and are not currently scheduled (e.g., Small Point Mining Range off the coast of Maine).

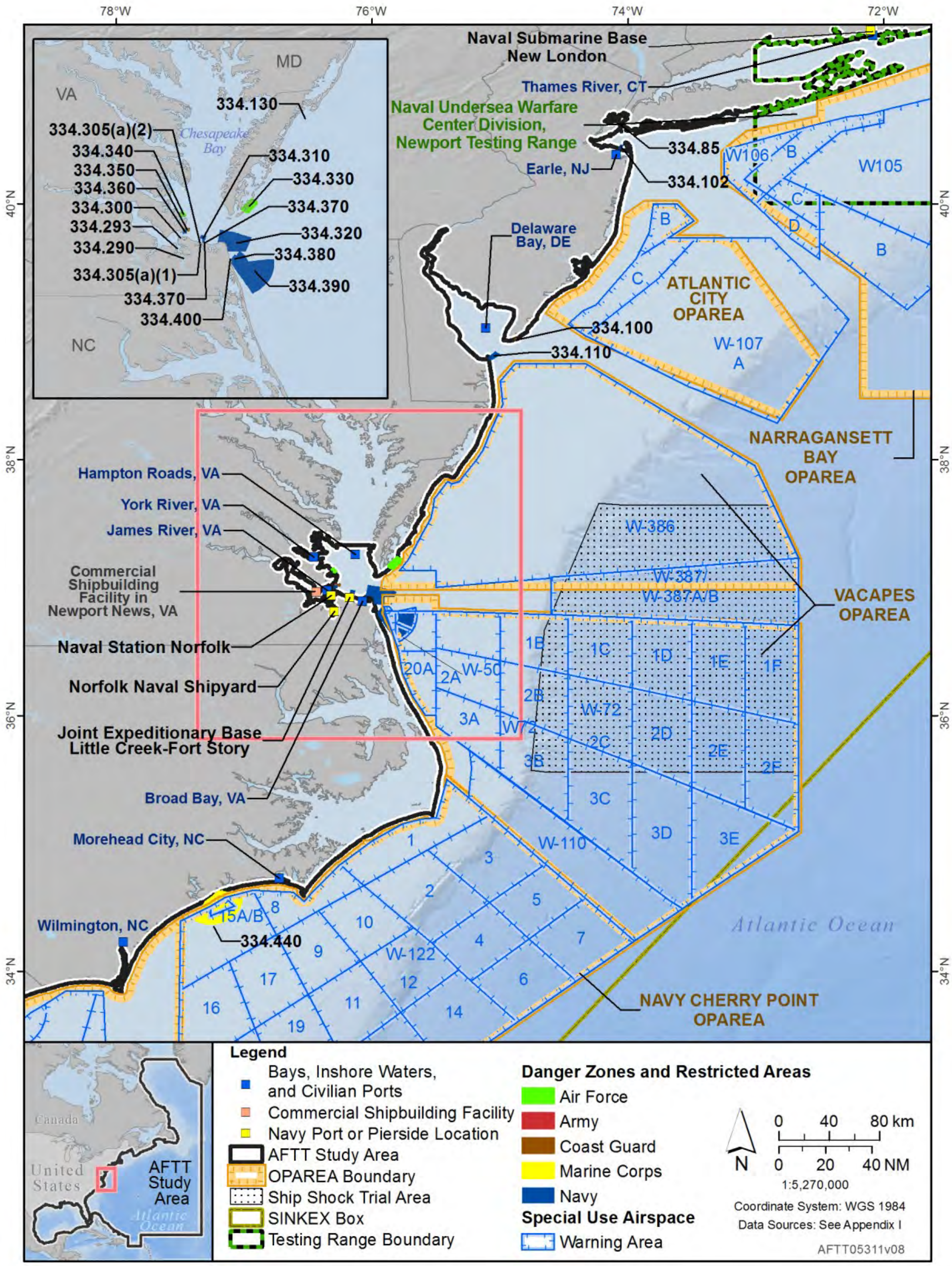
Accessibility, or restrictions to the availability of air and ocean space, would be a temporary condition. While mariners and pilots have a responsibility to be aware of conditions on the ocean and in the air, it is not expected that direct conflicts in accessibility would occur. The locations of restricted areas are published and available to mariners and pilots, who typically review such information before boating or flying in any area. Restricted areas are typically avoided by experienced mariners and pilots. Prior to initiating a training activity, the Navy would follow standard operating procedures to visually scan an area to ensure that nonparticipants are not present. If nonparticipants are present, the Navy delays, moves, or cancels its activity. Accessibility is no longer restricted once the activity concludes. In addition, project review and approval processes for many ongoing and planned offshore projects in the Study Area (i.e., oil and gas leasing, and wind energy projects) have integrated Navy input and review to reduce the potential for conflicts to air and ocean space. Therefore, there would be minimal potential for access to the ocean and airspace to directly impact human activities.

The Federal Aviation Administration is responsible for all of the national airspace, and the DoD and the Federal Aviation Administration cooperate in managing the airspace used by the military to support training and testing requirements. Special Use Airspace (Military Operations Areas and Restricted Areas over land, and Warning Areas over the ocean) is scheduled by the military and is released to the Federal Aviation Administration when not in use by the military. For special use airspace that is below 18,000 ft., non-military air routes already overlay Special Use Airspace. The Navy accommodates the needs of commercial and civilian aviation by maintaining a working relationship with the Federal Aviation Administration.



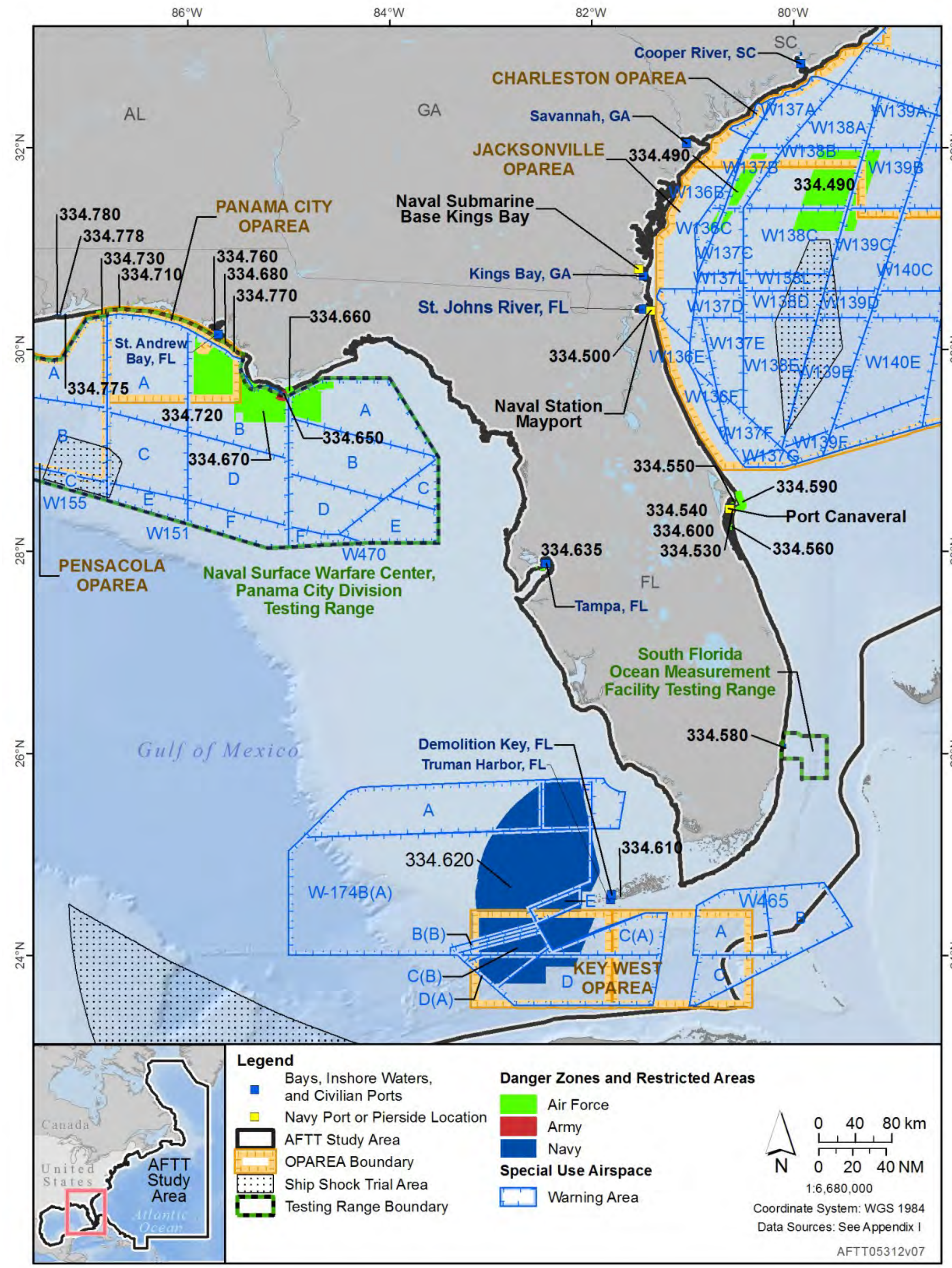
Notes: (1) AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area (2) The numerical labels refer to the part of 33 CFR Section 334 defining the danger zone or restricted area

Figure 3.11-12: Danger Zones and Restricted Areas in the Northeast Atlantic Ocean



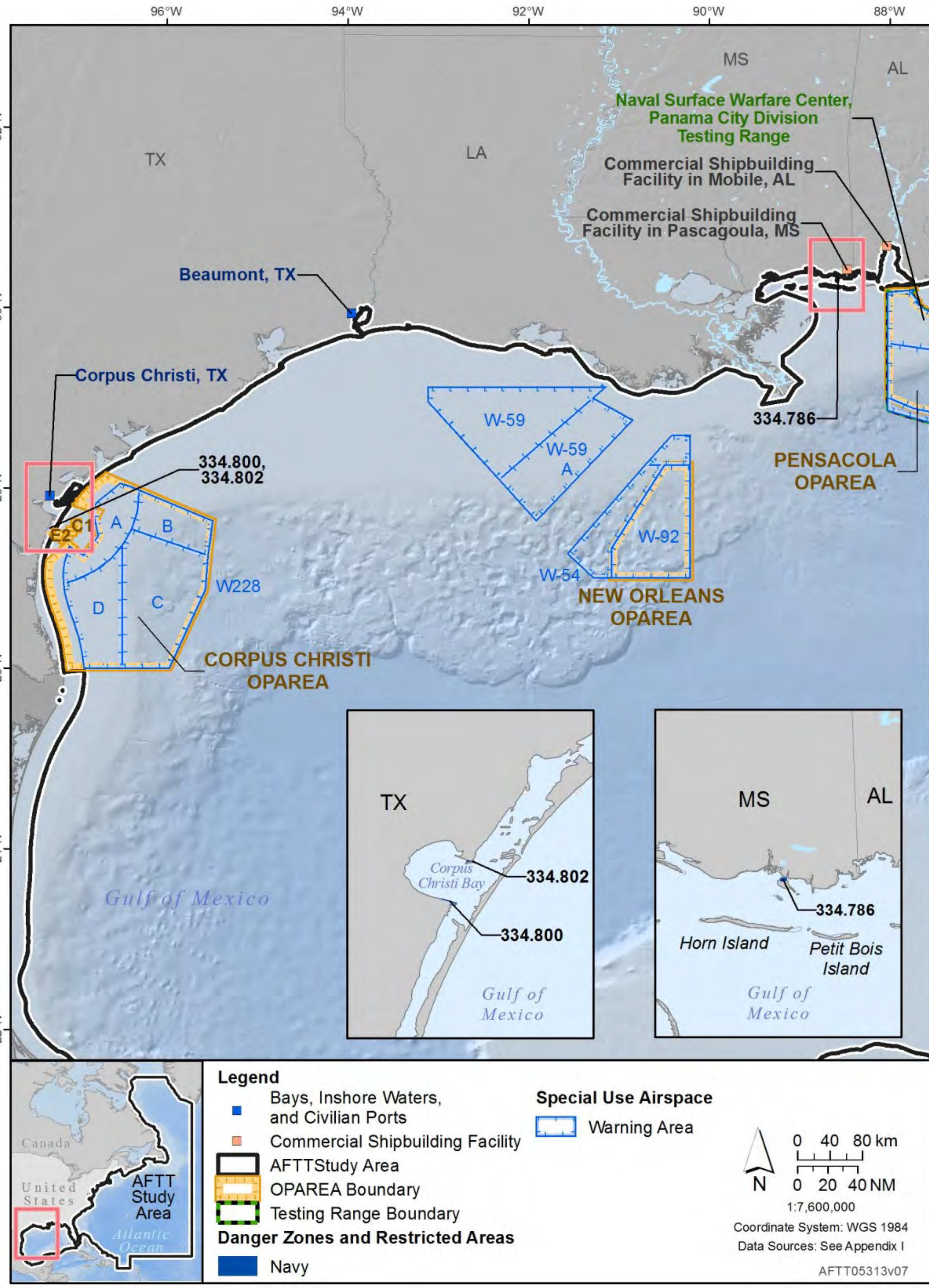
Notes: (1) AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area; VACAPES: Virginia Capes; SINKEX: Sinking Exercise
(2) The numerical labels refer to the part of 33 CFR Section 334 defining the danger zone or restricted area

Figure 3.11-13: Danger Zones and Restricted Areas in the Mid-Atlantic Ocean



Notes: (1) AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area (2) The numerical labels refer to the part of 33 CFR Section 334 defining the danger zone or restricted area

Figure 3.11-14: Danger Zones and Restricted Areas in the Southeast Atlantic Ocean and Eastern Gulf of Mexico



Notes: (1) AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area (2) The numerical labels refer to the part of 33 CFR Section 334 defining the danger zone or restricted area

Figure 3.11-15: Danger Zones and Restricted Areas in the Western Gulf of Mexico

3.11.3.1.1 Impacts on Socioeconomic Activities from Limiting Accessibility

3.11.3.1.1.1 Sources of Energy Production and Distribution

Water

Water-related energy generation facilities are planned in state waters along the east coast, and preliminary permits have been issued by the Federal Energy Regulatory Commission for production of renewable energy (tidal and wave energy), including a residential tidal energy project for underwater turbines along the shoreline near the shipyard in Bath, Maine. In accordance with the 2010 Memorandum of Understanding between the U.S. Department of Agriculture and the U.S. Navy (U.S. Department of the Navy, 2010), the Navy participates in the siting and review of renewable energy projects by sharing technical information with the objective of ensuring compatibility and minimizing conflicts in shared space. Research and testing activities by academic institutions for water energy technology is conducted along the Atlantic coast and Florida and would continue to be conducted in consideration of existing restricted areas on the ocean. Therefore, access to water-related sources of energy generation in the Study Area would not be hindered and there would be no change to operations during AFTT training or testing activities.

Wind

While the United States has no offshore wind energy generating capacity at this time, such projects are in the early planning stages. The U.S. Department of the Interior has approved an ocean lease to Cape Wind Associates, LLC to construct 130 wind turbines in Nantucket Sound within the Study Area. There are no Navy activities at or immediately near the Cape Wind Associates, LLC lease blocks. Access to this future wind energy site would not be hindered, and there would be no change to operations during AFTT training or testing activities.

Similar projects have been proposed along the East Coast. In November 2010, the Department of the Interior announced the "Smart from the Start" initiative to accelerate development of wind energy along the Atlantic Outer Continental Shelf. The initiative calls for the identification of areas on the Atlantic Outer Continental Shelf that appear most suitable for commercial wind energy and for the opening of these areas for leasing and site assessment. Areas from Maine to Florida have been identified for offshore wind energy development. The resultant wind energy areas will be developed and refined through extensive consultation with other federal agencies, to include the Navy and the Intergovernmental Renewable Energy Task Force of each affected state.

Future offshore wind energy projects projected along the Atlantic coast and Florida will be proposed and developed in consideration of existing DoD restricted area airspace and sea space required in support of military operations. Therefore, access to future offshore wind energy sites would not be hindered, and there would be no change to operations during AFTT training or testing activities.

Oil and Gas Production

While there are many oil and natural gas leases and an extensive oil and natural gas pipeline network in the Gulf of Mexico, conflicts with military activities are avoided through cooperative efforts between the DoD and oil and gas operators. Because the DoD plays an active role in the oversight of proposed oil and gas lease areas on the outer continental shelf, lease areas would generally not be approved in, or in conflict with, established or otherwise restricted offshore military use areas. In cases where such areas are leased, stipulations to the leases are established to resolve conflicts. Future oil and natural gas production interests along the Atlantic coast and Gulf of Mexico would operate in consideration of existing restricted areas on the ocean and in the air. Therefore, access to future oil and natural gas infrastructure would not be hindered, and there would be no change to operations during AFTT training or testing activities.

3.11.3.1.1.2 Mineral Extraction

Mineral extraction sites operate with the use of vessels and equipment that traverse the open ocean or are stationary (e.g., suction hopper dredges). Extraction of sand and gravel can be accomplished with the use of submerged or floating pipelines. Any changes in accessibility to offshore sites would not be expected to result in rerouting of vessels or postponing of operations. Any changes in accessibility for sand and gravel mining, or borrow sites, would have a short-term duration (typically one and one-half to four hours per location). Direct impacts on mineral extraction activities would be negligible.

3.11.3.1.1.3 Commercial Transportation and Shipping

There are no anticipated impacts on commercial shipping activities in the Study Area since naval vessels conducting hazardous activities generally occur away from commercially used waterways.

Any direct impacts on private civilian transportation activities from rerouting or postponing activities would be negligible due to advance public notification through the use of Notices to Mariners and Notices to Airmen and the primarily short-term duration (typically one and one-half to four hours per location) of military activities.

3.11.3.1.1.4 Commercial and Recreational Fishing

Favored fishing areas change over time with fluctuations in fish populations and communities, preferred target species, or fishing modes and styles. Popular fishing sites are characterized by relative ease of access (most recreational fishing trips occur in state waters), ability to anchor or secure the boat, and abundant presence of target fish. Impacts on commercial and recreational fishing may result when Navy activities restrict access to fishing areas or if Navy activities cause fish to abandon a popular fishing site. Refer to Section 3.6.3.1.1.4 (Physiological Stress) in Section 3.6 (Fishes) for analysis and discussion of potential population-level impacts Navy training and testing may have on fishes. The Navy strives to conduct its operations in a manner compatible with commercial and recreational ocean users by minimizing temporary access restrictions. Notices to Mariners allow commercial and recreational fishing boats to adjust their routes to avoid temporary restricted areas. Given the size of the Study Area, the opportunities for Navy activities to interfere with commercial and recreational fishing are minimal because the majority of fishing would occur closer to the shore. Because the proposed activities would not lead to a noticeable change in Navy presence, and because the proposed locations for these activities do not differ much from historical use, it is unlikely that commercial and recreational fishing activities would be noticeably affected by Navy activities requiring area restrictions.

3.11.3.1.1.5 Aquaculture

As discussed for commercial and recreational fishing, the federal government, through the U.S. Army Corps of Engineers, U.S. Coast Guard, U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and U.S. Environmental Protection Agency, implements an assurance that U.S. navigational routes are maintained when approving aquaculture lease stipulations. Thus, it is assumed that whenever possible, close coordination between all users of the waterway would be required under the aquaculture lease stipulations. Navy activities that could impact aquaculture would not be planned close to inshore or offshore areas with aquaculture activities. Because the proposed activities would not lead to a noticeable change in Navy presence and because the proposed locations for these activities do not differ much from historical use, there would be no direct effect on the use of remotely operated feed buoys at the University of New Hampshire offshore demonstration site or on divers who monitor the growth cages at shellfish or vegetation aquaculture sites.

3.11.3.1.1.6 Tourism

Tourism activities make an appreciable contribution to the overall economy within the Study Area. The Navy strives to conduct its operations in a manner compatible with recreational ocean users by minimizing temporary access restrictions. Published notices allow recreational users to adjust their routes to avoid temporary restricted areas.

Mariners and pilots engaged in tourism-related activities have a responsibility to be aware of conditions on the ocean and in the air. The locations of restricted areas are published and available to mariners and pilots, who typically review such information before boating or flying in any area. Restricted areas are typically avoided by mariners and pilots. The Navy would follow standard operating procedures to visually scan an area to ensure that nonparticipants are not present. If nonparticipants are present, the Navy delays, moves, or cancels its activity. Accessibility is no longer restricted once the activity concludes. Any changes to accessibility of air and ocean space would be a temporary condition for marine-related tourist and recreational activities. The revenues listed in Tables 3.11-2 through 3.11-5 would not be impacted by limiting access because restrictions on access would be temporary. The proposed activities would not lead to a noticeable change in Navy presence, and the proposed locations for these activities do not differ much from historical use; therefore, it is unlikely tourism would be noticeably affected by Navy activities requiring area restrictions.

The Navy has received comments on previous EISs expressing concern that marine mammals could be extirpated from areas where they have been observed or otherwise available for whale watching and similar recreational or tourist activities. As described in detail in Section 3.7 (Marine Mammals), Navy training and testing has been occurring in the same areas for decades, and there are no data or other information to indicate that populations of any marine mammals, including those popular with whale watchers, have been or would be affected. This assessment is based on four indicators from areas in the Pacific where Navy training and testing has continued for decades: (1) evidence suggesting or documenting increases in the numbers of marine mammals present in areas where Navy operates, (2) examples of documented presence and site fidelity of species and long-term residence by individual animals of some species, (3) use of training and testing areas for breeding and nursing activities, and (4) eight years of comprehensive monitoring data indicating a lack of any observable effects to marine mammal populations as a result of Navy training and testing activities. Therefore, no effects on wildlife viewing and other wildlife-dependent recreational activities and no economic effects on tourism (such as whale watching) and related businesses dependent on observing wildlife in their natural habitats are anticipated.

3.11.3.1.1.7 Impacts on Accessibility under Alternative 1

<u>**Impacts on Accessibility under Alternative 1 for Training Activities**</u>

Under Alternative 1, potential accessibility issues would be associated primarily with air warfare, surface warfare, anti-submarine warfare, mine warfare, amphibious warfare, and expeditionary warfare. Training activities in these warfare areas would continue at current levels and within established ranges and training locations, including the Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes and Other AFTT Areas. There would be no anticipated impacts on energy production, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, aquaculture, or tourism because inaccessibility to areas of co-use would be temporary and of short duration (typically one and one-half to four hours per location). Based on the Navy's standard operating procedures and the large expanse of the training ranges, accessibility issues would be negligible.

Impacts on Accessibility under Alternative 1 for Testing Activities

Under Alternative 1, potential accessibility issues would be associated primarily with air warfare, surface warfare, anti-submarine warfare, mine warfare, amphibious warfare, expeditionary warfare, sea trials, shock trials, and other weapons platform testing. Testing activities would continue at current levels and within established training and testing ranges, including the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes; Naval Undersea Warfare Center Division, Newport Testing Range; Naval Surface Warfare Center, Panama City Testing Range; and Other AFTT Areas. There would be no anticipated impacts on energy production, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, aquaculture, or tourism because inaccessibility to areas of co-use would be temporary and of short duration (typically one and one-half to four hours per location). Based on the Navy's standard operating procedures and the large expanse of the training ranges, accessibility impacts would be negligible.

3.11.3.1.1.8 Impacts on Accessibility under Alternative 2

Alternative 2 consists of the activities described under Alternative 1 but with a nominal increase in the use of some sonar systems, explosives, and associated vessel and aircraft activity. The locations of these activities would remain the same as described under Alternative 1. Alternative 2 also includes the training and testing of personnel required for proficiency with these systems.

Impacts on Accessibility under Alternative 2 for Training Activities

Under Alternative 2, potential accessibility issues would be the same as those associated with Alternative 1. There would be no changes to the Navy's standard operating procedures for public access to ocean and airspace. There would be no anticipated impacts from Alternative 2 training activities on energy production, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, aquaculture, or tourism, because inaccessibility to areas of co-use would be temporary and of short duration (typically one and one-half to four hours per location). Based on the Navy's standard operating procedures and the expansion of the Study Area, accessibility issues would be minor.

Impacts on Accessibility under Alternative 2 for Testing Activities

Under Alternative 2, potential accessibility issues would be the same as those associated with Alternative 1. Testing of some sonar systems would increase nominally within the Study Area. There would be no changes to the Navy's standard operating procedures for public access to testing ranges and other areas used for testing. There would be no anticipated impacts from Alternative 2 testing activities on energy production, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, aquaculture, or tourism because inaccessibility to areas of co-use would be temporary and short duration (typically one and one-half to four hours per location). Based on the Navy's standard operating procedures and the expansion of the Study Area, accessibility issues would be minor.

3.11.3.1.1.9 Impacts on Accessibility under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various accessibility stressors (e.g., limits on access to desirable fishing locations) would not be introduced into the marine environment. Training and testing activities have occurred throughout the Study Area for decades, resulting in and sustaining increases in jobs, military and civilian infrastructure, and population growth in numerous towns, cities, and regions located along the Atlantic and Gulf coasts. While it is reasonable to assume that ceasing training and testing activities associated with the Proposed Action would make certain areas where the Navy has conducted training and testing more accessible (i.e., available to the public more often), Navy OPAREAs and testing ranges are used for other purposes and would likely remain in place for the foreseeable future. Military activities would continue to occur in some of the same areas. Furthermore, the Navy has implemented a number of methods to communicate upcoming activities that would result in temporary restrictions on access to training and testing areas. These methods, which include Notices to Mariners, Notices to Airmen, broadcasts on marine band radio, website postings, and direct communication with the public through media and local organizations, serve to reduce impacts of limits on accessibility.

Ceasing training and testing activities may reduce the number and types of jobs available in locations where the Navy is a vital or even the primary economic driver sustaining local communities. For example, the use of munitions and other equipment used for training and testing activities under the Proposed Action would no longer be needed and, consequently, the number of jobs supporting those industries may be reduced or, alternatively, some jobs may be relocated. The secondary effects from reducing personnel who support Navy training and testing activities could include a decline in local business and a decrease in the need for infrastructure, such as schools. If jobs are relocated, a smaller population may no longer be able to sustain the local economy that developed to support the larger population. While more complex studies at the local level would need to be conducted to quantify potential socioeconomic impacts from ceasing training and testing activities, it is highly likely that many coastal communities would be impacted.

3.11.3.1.2 Summary of Potential Impacts on Accessibility

Access restrictions in the Navy training and testing areas would be temporary, and these conditions would return to normal upon completion of training and testing activities. These conditions would not result in a direct loss of income, revenue, employment, resource availability, or quality of experience.

3.11.3.2 Impacts from Airborne Acoustics

As an environmental stressor, loud noises, sonic booms, and vibrations generated from Navy training and testing activities such as weapons firing, in-air explosions, and aircraft transiting have the potential to disrupt wildlife and humans in the Study Area. The public might intermittently hear noise from ships or aircraft overflights if they are in the general vicinity of a training or testing event, but there would be no impact on public health and safety because of the infrequency and duration of events (Section 3.12, Public Health and Safety).

3.11.3.2.1 Impacts on Socioeconomic Activities from Airborne Acoustics

Airborne noise would not impact energy production and distribution, mineral extraction, commercial transportation and shipping, or aquaculture. Based on the analysis of impacts from the Proposed Action, fish would not experience substantial impacts from airborne acoustics (Section 3.6, Fishes). Marine invertebrates (Section 3.4, Invertebrates), also important commercial fishery resources, would not be affected by airborne acoustics because most marine species are limited in their ability to detect airborne sound. Therefore, airborne noise from Navy activities would not impact the availability of commercially and recreationally valuable species.

Noise interference could decrease public enjoyment of recreational activities. These effects would occur on a temporary basis, only when weapons firing, in-air explosions, and aircraft transiting occur. Of these activities, Navy activities involving weapons firing and in-air explosions would only occur when the Navy can confirm the area is clear of commercial and recreational boaters and other nonparticipants, reducing the likelihood these activities would be a disturbance.

An aircraft traveling at supersonic speeds has the potential to generate sonic booms heard at ground level. A sonic boom is the "thunder-like" noise a person on the ground hears when an aircraft flies overhead faster than the speed of sound (i.e., supersonic). Not all supersonic flights generate sonic booms that are detectable on the ground. When a sonic boom reaches ground level it may vary widely in intensity. The factors that influence the occurrence and intensity of a sonic boom include the weight, size, and shape of the aircraft; the altitude, attitude, and flight path of the aircraft; and the weather or atmospheric conditions where the boom is generated and at ground level.

Sonic booms shall not be intentionally generated below 30,000 ft. of altitude unless over water and more than 30 NM from inhabited coastal areas or islands, although deviation from these guidelines may be authorized for tactical missions that require supersonic speeds, phases of formal training requiring supersonic speeds or research, test and operational suitability test flights that require supersonic speeds (U.S. Department of the Navy, 2016). Supersonic test flights regularly occur in airspace, referred to as the supersonic Test Track, located at least 3 NM offshore and within W-386 in the Virginia Capes Range Complex. The test track extends along the coastline of the Delmarva Peninsula, which separates the Chesapeake Bay to the west and the Atlantic Ocean to the east, and includes portions of Delaware, Maryland, and Virginia. The majority of supersonic flights are in support of Naval Air Systems Command Research Development Acquisition Testing & Evaluation activities, but Navy training flights may also use the Test Track. In addition, other military aircraft and even commercial test flights have used the Test Track in the past. Supersonic test flights in the Test Track are conducted under highly controlled conditions to enable the collection of empirical data that are used to evaluate the performance, reliability, and safety of new aircraft systems under high airspeed conditions.

NAVAIR has received noise complaints from coastal residents in Virginia, Maryland, Delaware and as far north as New Jersey, associated with 15 Navy supersonic flights over a three-year period, for an average of five supersonic flights per year. Therefore, due to the infrequent occurrence of sonic booms, they are unlikely to deter a resident or tourist from participating in a recreational activity (e.g., a fishing trip) in near shore or offshore areas. Most naval aircraft training and testing would occur well out to sea, while civilian recreational activities are concentrated within a few miles of shore, resulting in minimal overlap and negligible impacts. Tourism and recreational activity revenue (Table 3.11-6) is not expected to be impacted by airborne noise.

3.11.3.2.1.1 Impacts from Airborne Acoustics under Alternative 1

Impacts from Airborne Acoustics under Alternative 1 for Training Activities

Under Alternative 1, potential airborne noise impacts would be associated primarily with air warfare, surface warfare, anti-submarine warfare, mine warfare, and amphibious warfare. Training activities in these warfare areas would continue at current levels and within established ranges and training locations, including the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes. There would be no anticipated impacts on energy production and distribution, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, and aquaculture, because acoustic conditions would have no effect on these activities and the training area would be free of nonparticipants. Navy operational procedures and practices are already in place to avoid impacts on civilian activities in the training areas. Navy training activities producing airborne noise typically occur infrequently and have a short duration (hours). Therefore, airborne noise impacts on tourism and recreational activity would be negligible.

Impacts from Airborne Acoustics under Alternative 1 for Testing Activities

Under Alternative 1, potential airborne noise impacts would be associated primarily with air warfare, surface warfare, anti-submarine warfare, mine warfare, amphibious warfare, sea trials, and other weapons platform testing. Testing activities would continue at current levels and within established training and testing ranges, including the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes; Naval Undersea Warfare Center Division, Newport Testing Range; and Naval Surface Warfare Center, Panama City Division Testing Range. There would be no anticipated impacts on energy production and distribution, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, and aquaculture, because acoustic conditions would have no effect on these activities and the testing area would be free of nonparticipants. Navy operational procedures and practices are already in place to avoid impacts on civilian activities in the testing areas. Navy testing activities producing airborne noise typically occur infrequently and have a short duration (hours).

When the airspace is available and testing requirements allow, supersonic flights are scheduled offshore to avoid potential impacts from sonic booms. However, in some instances, supersonic flights cannot be moved due to mission requirements or airspace congestion. Since atmospheric conditions can affect the intensity of a sonic boom, the wind speed, wind direction, air temperature, and atmospheric pressure are all monitored prior to a supersonic testing event to help determine the likelihood that a sonic boom would be detected at ground level. However, atmospheric conditions can change rapidly in the offshore environment, which can affect the intensity of a sonic boom at ground level. While the pre-flight check of atmospheric conditions may have indicated that there would be a low probability of a sonic boom reaching the coastline, if conditions change during the flight an unexpectedly intense sonic boom may be detected at ground level. To help limit impacts from supersonic test flights, test pilots receive annual noise mitigation training to maintain their awareness of the potential noise impacts resulting from their flights. Based on the analysis presented in the sections above, any infrequent and brief airborne noise impacts on tourism and recreational activity would be negligible.

3.11.3.2.1.2 Impacts from Airborne Acoustics under Alternative 2

Alternative 2 consists of the activities described under Alternative 1 but with a nominal increase in the use of some sonar systems, explosives, and associated vessel and aircraft activity. The locations of these activities would remain the same as described under Alternative 1. Alternative 2 also includes the training and testing of personnel required for proficiency with these systems.

Impacts from Airborne Acoustics under Alternative 2 for Training Activities

Under Alternative 2, airborne noise issues would be the same as those associated with Alternative 1, with the exception of a nominal increase in vessel and aircraft activity associated with an increase in the use of some sonar systems. However, the increase in airborne noise would be negligible. There would be no anticipated impacts from Alternative 2 training activities on energy production and distribution, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, aquaculture, or tourism, because acoustic conditions would have no effect on these activities and the training area would be free of nonparticipants. Navy operational procedures and practices are already in place to avoid impacts on ongoing activities in the testing areas. Navy training activities producing airborne noise typically occur infrequently and have a short duration (hours). Therefore, airborne noise impacts on tourism and recreational activity would be negligible.

Impacts from Airborne Acoustics under Alternative 2 for Testing Activities

Under Alternative 2, airborne noise issues would be the same as those associated with Alternative 1, with the exception of a nominal increase in vessel and aircraft activity associated with an increase in the use of some sonar systems and explosives. However, the increase in airborne noise would be negligible. There would be no anticipated impacts from Alternative 2 testing activities on energy production and distribution, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, and aquaculture, because acoustic conditions would have no effect on these activities and the testing area would be free of nonparticipants. Navy operational procedures and practices are already in place to avoid impacts on ongoing activities in the testing areas. Navy testing activities producing airborne noise typically occur infrequently and have a short duration (hours). Therefore, airborne noise impacts on tourism and recreational activity would be negligible.

3.11.3.2.1.3 Impacts from Airborne Acoustics under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various airborne acoustic stressors (e.g., noise affecting tourism) would not be introduced into the marine environment. Training and testing activities have occurred throughout the Study Area for decades, resulting in and sustaining increases in jobs, military and civilian infrastructure, and population growth in numerous towns, cities, and regions located along the Atlantic and Gulf coasts. While it is reasonable to assume that ceasing training and testing activities associated with the Proposed Action would reduce airborne noise, the effect would be negligible, because other commercial and non-military activities (e.g., shipping and recreational boating) that produce airborne noise occur at a higher tempo and closer to shore than Navy training and testing activities.

Ceasing training and testing activities may reduce the number and types jobs available in locations where the Navy is a vital or even the primary economic driver sustaining local communities. For example, the use of munitions and other equipment used for training and testing activities would no longer be needed and, consequently, the number of jobs supporting those industries may be reduced or alternatively, some jobs may be relocated. The secondary effects from reducing personnel who conduct and support Navy training and testing activities could include a decline in local business and a decrease in the need for infrastructure, such as schools. If jobs are relocated, a smaller population may no longer be able to sustain the local economy that developed to support the larger population. While more complex studies at the local level would need to be conducted to quantify potential socioeconomic impacts from ceasing training and testing activities, it is highly likely that many coastal communities would be impacted.

3.11.3.2.2 Summary of Potential Impacts from Airborne Acoustics

Because the majority of Navy training and testing activities are conducted far from where tourism and recreational activities are concentrated, the impact of airborne noise would be negligible. The public might intermittently hear noise from transiting ships or aircraft overflights if they are in the general vicinity of a training or testing activity, but these occurrences would be infrequent. The infrequent exposure to airborne noise would not result in a direct loss of income, revenue or employment, resource availability, or quality of experience.

3.11.3.3 Physical Disturbance and Strike Stressors

The evaluation of impacts on socioeconomic resources from physical stressors focuses on direct physical encounters or collisions with objects moving through the water or air (e.g., vessels, aircraft, unmanned devices, and towed devices), dropped or fired into the water (non-explosive practice munitions, other military expended materials, and seafloor devices), or resting on the ocean floor (anchors, mines, and targets) that may damage or encounter civilian equipment. Physical disturbances that damage equipment and infrastructure could disrupt the collection and transport of products, which may impact industry revenue or operating costs.

Navy training and testing equipment and vessels moving through the water could collide with non-Navy vessels and equipment. Most of the training and testing activities involve vessel movement and use of towed devices. However, the likelihood that a Navy vessel would collide with a non-Navy vessel is remote, because of the use of navigational aids or buoys separating vessel traffic, shipboard lookouts, radar, and marine band radio communications by both Navy and civilians. Therefore, the potential to impact commercial transportation and shipping by physical disturbance or strike is negligible and requires no further analysis.

Aircraft conducting training or testing activities in the Study Area operate in designated military special use airspace (e.g., warning areas, military operations areas, and restricted areas). All aircraft, military and civilian, are subject to Federal Aviation Administration regulations, which define permissible uses of designated airspace, and are implemented to control those uses. These regulations are intended to accommodate the various categories of aviation, whether military, commercial, or general aviation. By adhering to these regulations, the likelihood of civilian aircraft coming into contact with military aircraft or munitions is remote. In addition, Navy aircraft follow procedures outlined in Navy air operations manuals, which are specific to a warning area or other special use airspace, and which describe procedures for operating safely when civilian aircraft are in the vicinity.

Military expended materials can physically interact with civilian equipment and infrastructure. Many of the training and testing activities use military expended materials including chaff, flares, projectiles, casings, target fragments, missile fragments, rocket fragments, ballast weights, and mine shapes.

3.11.3.3.1 Impacts on Socioeconomic Activities from Physical Disturbance and Strike Stressors

3.11.3.3.1.1 Sources of Energy Production and Distribution

The evaluation of impacts on energy production and distribution in the Study Area from physical disturbances or strikes focuses on objects moving through the water or air, dropped into the water, or resting on the ocean floor that may damage equipment or otherwise inhibit production. Military expended materials that damage equipment and infrastructure could disrupt energy production and distribution, which may impact industry revenue and operating costs. The Navy does not perform activities that would release military expended materials near known, submerged equipment or infrastructure. Therefore, the probability that Navy activities would disrupt energy production and distribution or damage infrastructure by physical strikes would be negligible.

3.11.3.3.1.2 Mineral Extraction

Similar to the potential impacts on sources of energy production, physical disturbances or strikes could damage equipment and inhibit extraction processes. Military expended materials that inadvertently snag, entangle, or damage sand and gravel extraction equipment or disrupt the sand and gravel extraction process may impact industry revenue and operating costs. The Navy implements standard operating procedures for clearing training and testing areas before initiating hazardous activities. Navy activities that expend materials that ultimately reside on the seafloor are typically conducted in offshore waters beyond the location of accessible sand and gravel sources. If military expended materials were encountered during the extraction process, they would first encounter the dragheads, which are the first point of contact with bottom materials on a suction dredger. The dragheads and the extraction process are designed with the expectation that debris may be encountered during the extraction process. The dragheads aid in filtering out debris to reduce the likelihood of a blockage from debris encountered during the dredging or extraction process. The Navy would avoid conducting training and testing in areas of mineral extraction, and it is unlikely that military expended materials from training and testing activities would be transported onto sand and gravel sources. Therefore, the potential for Navy activities to disrupt or disturb mineral extraction vessels or equipment by physical disturbances or strikes would be negligible.

3.11.3.3.1.3 Commercial Transportation and Shipping

There would be no anticipated impacts on commercial transportation activities in the Study Area, because naval vessels and aircraft conducting training and testing generally conduct these activities far from commercially used waterways and airways. While physical disturbances or strikes could damage commercial marine vessels or aircraft, the Navy implements standard operating procedures for clearing training and testing areas of all nonparticipants before initiating hazardous activities. Therefore, the potential for Navy activities to disrupt or disturb commercial vessels or aircraft by physical disturbances or strikes would be negligible.

3.11.3.3.1.4 Commercial and Recreational Fishing

The majority of commercial and recreational fishing in the Study Area takes place in state waters, less than 3 NM from shore, where the Navy conducts very limited training and testing activities. Approximately 10 percent of fish caught during recreational fishing trips are caught in federal waters, which extend seaward beyond 3 NM from shore (9 NM for Texas, Puerto Rico, and Florida’s Gulf coast). Therefore, most recreational fishing would occur far from physical disturbances and strikes associated with training and testing activities. Some commercial fishing may occur beyond state waters in Navy training and testing areas and could be affected by the proposed activities if those activities were to alter fish population levels in those areas to such an extent that commercial fishers would no longer be able to find their target species. As described in Section 3.6.3 (Fishes, Environmental Consequences), the behavioral responses that could occur from various types of physical stressors associated with training and testing activities would not compromise the general health or condition of fishes or populations of fishes.

Section 3.6.3 (Fishes, Environmental Consequences) also evaluated potential impacts on fish habitat from physical disturbances, strikes (by small-, medium-, and large-projectiles), and the use of electromagnetic and towed devices. Physical disturbances and strikes would be concentrated within designated gunnery box areas, resulting in localized disturbances of hard bottom areas, but could occur anywhere in the Study Area. Direct and indirect impacts on the fishes using hard bottom habitat in the Study Area could occur. The use of electromagnetic devices would not harm fishes, result in behavioral responses, or affect habitat. The use of towed devices may result in short-term and localized movement of fishes to avoid the device; however, long-term avoidance of an area is not anticipated. Impacts on populations of fishes in the Study Area would not be expected, and, therefore, loss of revenue or employment by commercial fishers would not occur. No impacts on recreational fishing in the Study Area would be anticipated.

Commercial fishing activities have the potential to be impacted by military equipment placed in the water column or on the seafloor for use during Navy training and testing activities. This equipment could include ship anchors; moored or bottom-mounted targets, mines, and mine shapes; bottom-mounted tripods; and the use of towed system and attachment cables. Many different types of commercial fishing gear are used in the Study Area, including gillnets, longline gear, troll gear, trawls, seines, and traps or pots. Bottom fishing gear is the most common type of fishing gear used in the Study Area and is used to capture some of the most valued species (Table 3.11-1), and commercial bottom-fishing activities, such as dredging, bottom trawling, long lines, and pots and traps have the greatest potential to be impacted by materials expended during training and testing activities and that ultimately reside on the seafloor. For example, military expended materials, such as decelerators/parachutes, cables, and guidance wires, would ultimately sink to the seafloor and could inadvertently snag, entangle, and damage fishing equipment. Interaction with bottom-fishing gear could result in the loss of or damage to commercial fishing gear and Navy equipment. If events such as these were to occur, they could result in loss of income, revenue, and employment. Entanglement by fiber optic cables and guidance wires expended during training and testing activities would not result in destruction or adverse modification of fish habitat and is unlikely to be encountered by commercial fishers. Even if encountered, fiber optic cables are brittle and are likely to break easily if entangled with fishing gear.

The Navy recovers many of the targets (e.g., mines and mine shapes) and target fragments used in training and testing activities, and would continue to do so to minimize the potential for interaction with fishing gear and fishing vessels. Unrecoverable items are typically small, constructed of soft materials (e.g., cardboard boxes or tethered target balloons), or are intentionally designed to sink to the bottom after serving their purpose (such as expended 55-gallon steel drums), so that they would not represent a collision risk to vessels, including commercial fishing vessels. Although larger expended items, such as 55-gallon drums, may pose a risk to certain types of fishing gear used for bottom fishing, the probability of encountering such an item is remote given the large area over which expended materials would be distributed; the depth of the water where most activities using expended materials would occur; and the tendency for larger, heavier materials to become embedded in soft sediments, making them less likely to be snagged by fishing gear.

Based on the large size of the Study Area, the limited areas of concentrated military activity, and the advance release of Notices to Mariners prior to conducting activities, impacts on commercial or recreational fishing from physical disturbances and strikes in the Study Area would be rare; were they to occur, they would have a negligible economic impact on the commercial or recreational fishing industries.

3.11.3.3.1.5 Aquaculture

There are no anticipated direct impacts from physical stressors on the aquaculture industry, because there are no aquaculture farms in any of the range complexes or testing ranges, the directional waterways used by naval vessels, or the training areas in the Chesapeake Bay. There is a limited possibility that physical disturbances on the ocean floor such as ship anchoring, expended material residing on the seafloor, moored mines, bottom-mounted tripods, and the use of towed systems and attachment cables could inadvertently damage aquaculture gear. However, the shallow water, nearshore locations of most aquaculture activities would not coincide with the locations of training and testing activities that have the potential to impact aquaculture.

3.11.3.3.1.6 Tourism

While Navy training and testing activities can occur throughout the Study Area, most (especially hazardous) activities occur well out to sea. Most civilian recreational activities engaged in by both tourists and residents take place within a few miles of land or in many cases along the shoreline.

Recreational diving and snorkeling activities within the Study Area take place primarily at known diving sites, including shipwrecks and artificial reefs. The locations of these popular sites are well documented, boats are typically well marked, and diver-down flags would be visible from, and avoided by, Navy ships conducting training and testing activities. As a result, conflicts between training and testing activities within the offshore areas and recreational diving and snorkeling would not occur.

Other tourism activities such as whale watching, boating, or use of other watercraft or aircraft may occur farther offshore. Activities occurring farther from shore would usually be conducted from larger boats that are typically well marked and visible to Navy ships conducting training and testing activities. Individual boaters engaged in tourism activities such as whale watching monitor navigational information to avoid Navy training and testing areas. Vessel operators are responsible for being aware of designated danger zones in surface waters and any Notices to Mariners that are in effect. Operators of recreational or commercial vessels are responsible for abiding by U.S. Coast Guard maritime regulations. In conjunction with these responsibilities, Navy standard operating procedures require Navy vessels to ensure that an area is clear of nonparticipants before initiating training and testing activities. Conflicts between Navy training and testing in offshore areas and whale watching or other offshore recreational activities would not occur. The Navy would continue to recover larger pieces of targets used in certain training and testing activities so that target debris would not pose a collision risk to civilian vessels. Unrecoverable pieces of targets are typically small, constructed of soft materials such as cardboard, are pieces of a tethered target balloons, or are designed to sink to the seafloor after use and would not damage civilian vessels if encountered.

Changes to offshore tourism activities in the Study Area would not be expected, and, therefore, loss of revenue or employment associated with tourism would not be expected as a result of training and testing activities.

3.11.3.3.1.7 Impacts from Physical Disturbance and Strike Stressors under Alternative 1

<u>Impacts from Physical Disturbance and Strike Stressors under Alternative 1 from Training Activities</u>

Under Alternative 1, potential physical disturbance and strike impacts would be associated primarily with air warfare, surface warfare, anti-submarine warfare, mine warfare, and amphibious warfare. Training activities in these warfare areas would continue at current levels and within established ranges and training locations, including the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes.

There would be no anticipated impacts on energy production and distribution, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, aquaculture, or tourism, because of the large size of the Study Area, the limited areas of operations, and implementation of the Navy's standard operating procedures, which includes ensuring that an area is clear of all non-participating vessels before training activities take place. In addition, the Navy provides advance notification of training activities to the public through Notices to Mariners and postings on Navy websites. Damage to or loss of commercial equipment, such as fishing gear, energy production equipment, and mineral extraction equipment, from interaction with Navy vessels, equipment, or other expended materials is unlikely. The Navy recovers many practice munitions (e.g., mines and mine shapes) for reuse following the activity. The Navy also recovers larger floating objects or materials, such as targets or target fragments, to avoid having them become hazards to navigation. Smaller objects that remain in the water column would be unlikely to pose a risk to commercial equipment. Furthermore, the Navy will implement mitigation to avoid impacts from explosives and physical disturbance and strike stressors on seafloor resources in mitigation areas throughout the Study Area (Section 5.4.1, Mitigation Areas for Seafloor Resources). The mitigation areas will benefit shallow-water coral reefs, live hard bottom, artificial reefs, and shipwrecks, which are valuable components of the snorkeling, diving, and fishing industries. Considering the expansive size of the Navy's OPAREAs, the disbursement of military expended materials over these large areas, and the Navy's standard operation procedures and existing mitigation measures (Chapter 5, Mitigation), impacts from physical disturbances and strikes on energy production and distribution, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, aquaculture, and tourism would be negligible.

Impacts from Physical Disturbance and Strike Stressors under Alternative 1 from Testing Activities

Under Alternative 1, potential physical disturbance and strike would be associated primarily with air warfare, surface warfare, anti-submarine warfare, mine warfare, amphibious warfare, sea trials, and other weapons platform testing. Testing activities would continue at current levels and within established training and testing ranges, including the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, Key West, and Gulf of Mexico Range Complexes; Naval Undersea Warfare Center Division, Newport Testing Range; and Naval Surface Warfare Center, Panama City Division Testing Range.

There would be no anticipated impacts on energy production and distribution, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, aquaculture, or tourism, because the Navy's standard operating procedures require that a testing area is clear of nonparticipants before initiating testing activities. Furthermore, the Navy will implement mitigation to avoid impacts from explosives and physical disturbance and strike stressors on seafloor resources in mitigation areas throughout the Study Area (Section 5.4.1, Mitigation Areas for Seafloor Resources). The mitigation areas will benefit shallow-water coral reefs, live hard bottom, artificial reefs, and shipwrecks, which are valuable components of the snorkeling, diving, and fishing industries. Considering the expansive size of the Navy's OPAREAs and testing ranges, the wide distribution of military expended materials over these large areas, implementation of standard operating procedures and mitigation, and impacts from physical disturbances and strikes on commercial and recreational fishing, the likelihood of a physical disturbance or strike disrupting commercial or recreational activities in the Study Area would be negligible. Therefore, loss of revenue or employment changes to socioeconomic activities and resources in the Study Area would not be expected.

3.11.3.3.1.8 Impacts from Physical Disturbance and Strike Stressors under Alternative 2

Alternative 2 consists of the activities described under Alternative 1 but with a nominal increase in the use of some sonar systems and explosives associated vessel and aircraft activity. The locations of these activities would remain the same as described under Alternative 1. Alternative 2 also includes the training and testing of personnel required for proficiency with these systems.

Impacts from Physical Disturbance and Strike Stressors under Alternative 2 from Training Activities

Under Alternative 2, potential physical disturbance and strike impacts would be the same as described under Alternative 1, with the exception of a nominal increase in vessel and aircraft activity associated with an increase in the use of some sonar systems. However, the increase in the probability of a physical disturbance or strike would be negligible. There would be no anticipated impacts on energy production and distribution, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, aquaculture, or tourism, because of the large size of the Study Area, the limited areas of operations, and implementation of the Navy's standard operating procedures, which includes ensuring that an area is clear of all non-participating vessels before training activities take place. In addition, the Navy provides advance notification of training activities to the public through Notices to Mariners and postings on Navy websites. Damage to or loss of commercial equipment, such as fishing gear, energy production equipment, and mineral extraction equipment, from interaction with Navy equipment or other expended materials is unlikely. The Navy recovers many practice munitions (e.g., mines and mine shapes) for reuse following the activity. The Navy also recovers larger floating objects or materials, such as targets or target fragments, to avoid having them become hazards to navigation. Smaller objects that remain in the water column would be unlikely to pose a risk to commercial equipment. Considering the expansive size of the Navy's OPAREAs, the disbursement of military expended materials over these large areas, and the Navy's standard operation procedures and mitigation measures (Chapter 5, Mitigation), impacts from physical disturbances and strikes on energy production and distribution, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, aquaculture, and tourism would be negligible.

Impacts from Physical Disturbance and Strike Stressors under Alternative 2 from Testing Activities

Under Alternative 2, potential physical disturbance and strike impacts would be the same as described under Alternative 1, with the exception of a nominal increase in vessel and aircraft activity associated with an increase in the use of some sonar systems and explosives. However, the increase in the probability of a physical disturbance or strike would be negligible. There would be no anticipated impacts on energy production and distribution, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, aquaculture, or tourism, because of the large size of the Study Area, the limited areas of operations, and implementation of the Navy's standard operating procedures, which includes ensuring that an area is clear of all non-participating vessels before testing activities take place. In addition, the Navy provides advance notification of testing activities to the public through Notices to Mariners and postings on Navy websites. Damage to or loss of commercial equipment, such as fishing gear, energy production equipment, mineral extraction equipment, from interaction with Navy equipment or other expended materials is unlikely. The Navy recovers many practice munitions (e.g., mines and mine shapes) for reuse following the activity. The Navy also recovers larger floating objects or materials, such as targets or target fragments, to avoid having them become hazards to navigation. Smaller objects that remain in the water column would be unlikely to pose a risk to commercial equipment. Considering the expansive size of the Navy's OPAREAs, the disbursement of military expended materials over these large areas, and the Navy's standard operation procedures and mitigation measures (Chapter 5, Mitigation), impacts from physical disturbances and strikes energy production and distribution, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, aquaculture, and tourism would be negligible.

3.11.3.3.1.9 Impacts from Physical Disturbance and Strike Stressors under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various physical disturbance and strike stressors (e.g., disruption to fishing) would not be introduced into the marine environment. Training and testing activities have occurred throughout the Study Area for decades, resulting in and sustaining increases in jobs, military and civilian infrastructure, and population growth in numerous towns, cities, and regions located along the Atlantic and Gulf coasts. While it is reasonable to assume that ceasing training and testing activities associated with the Proposed Action would reduce the potential for disruption of civilian activities from physical disturbances or strikes, the effect would be negligible, because the likelihood of a disturbance, as described under Alternative 1, is already negligible.

Ceasing training and testing activities may reduce the number and types of jobs available in locations where the Navy is a vital or even the primary economic driver sustaining local communities. For example, the use of munitions and other equipment used for training and testing activities would no longer be needed, and, consequently, the number of jobs supporting those industries may be reduced or, alternatively, some jobs may be relocated. The secondary effects from reducing personnel who support Navy training and testing activities could include a decline in local business and a decrease in the need for infrastructure, such as schools. If jobs are relocated, a smaller population may no longer be able to sustain the local economy that developed to support the larger population. While more complex studies at the local level would need to be conducted to quantify potential socioeconomic impacts from ceasing training and testing activities, it is highly likely that many coastal communities would be impacted to varying degrees.

3.11.3.3.2 Summary of Potential Impacts from Physical Disturbance and Strike Stressors

Because the majority of Navy training and testing activities are conducted far from where commercial and recreational activities are concentrated, the potential for a physical disturbance or strike would be negligible. The public might intermittently observe a transiting ship or aircraft flying overhead if they are in the general vicinity of a training or testing activity, but these occurrences would be infrequent and of short duration. The Navy does not typically train or test in areas close to civilian infrastructure and activities and, based on the Navy's standard operating procedures and the large expanse of the testing and training ranges, the likelihood of a physical disturbance or strike disrupting commercial or recreational activities in the Study Area would be negligible. Therefore, loss of revenue or employment changes to socioeconomic activities and resources in the Study Area would not be expected.

3.11.4 Secondary Stressors

Socioeconomics could be indirectly impacted by training and testing activities if changes to physical and biological resources were to alter the way energy production and distribution, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, aquaculture, or tourism were conducted.

Impacts on sediment and water quality, fishes, invertebrates, and marine mammals were considered to be potential secondary stressors to socioeconomic resources. Impacts on sediment and water quality have the potential to affect habitat for fishes and invertebrates that are of vital importance to the commercial fishing industry, as well as recreational fishes and aquaculture and the local industries that support those activities. A portion of the tourism industry is also dependent on coastal and marine-based activities in both the Atlantic and Gulf coast regions and could be affected by impacts on fisheries. No indirect or secondary impacts on energy production and distribution and commercial transportation and shipping are anticipated.

Mineral extraction activities could be impacted if training and testing activities alter marine habitats in a way that reduces the availability of sand for beach nourishment projects. Long-term deposition of Navy expended materials on the ocean bottom was examined as a condition that could diminish availability of suitable sand for extraction. Mineral extraction operations could also be impacted if there were increases in costs due to the need to find alternate sites or if removal of military expended materials from active sites was required before extraction could commence. Because of the large size of the Study Area, the availability of offshore mineral resources along the Atlantic and Gulf coasts, and the likelihood that training and testing activities that expend materials would occur farther offshore, loss of revenue would not be expected. As discussed in Section 3.2 (Sediments and Water Quality), military expended materials would not impact sediment quality and availability or the cost of extracting mineral resources. Therefore, there would be no indirect socioeconomic impacts associated with training and testing activities on mineral extraction.

Commercial and recreational fishing, aquaculture, and tourism could be impacted if the proposed training and testing activities impacted fish or invertebrate populations to such an extent that species abundance was no longer sufficient to support these socioeconomic activities. Disturbances to marine mammal populations that result in abandonment of areas where whales are known to occur could impact the whale watching industry. However, no secondary impacts on socioeconomic resources would occur based on the results of analyses presented in Sections 3.4 (Invertebrates), 3.6 (Fishes), and 3.7 (Marine Mammals). These sections concluded that there would be no population-level impacts on marine species from training and testing activities, including from the use of sonar and other transducers. Therefore, indirect or secondary impacts on energy production and distribution, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, aquaculture, and tourism are not anticipated.

3.11.5 Summary of Potential Impacts on Socioeconomics

This section evaluates the potential impacts on socioeconomic resources from all stressors combined. The analysis and conclusions for the potential impacts from each of the individual stressors are discussed in the sections above. Stressors associated with Navy training and testing activities do not typically occur in isolation but rather occur in some combination. For example, anti-submarine warfare activities can include elements of airborne acoustics, physical disturbance and strike, and accessibility restrictions that are all coincident in space and time. An analysis of the combined impacts of all stressors considers the potential consequences of aggregate exposure to all stressors and the repetitive or additive consequences of exposure over multiple years. The stressors from the proposed training and testing activities that have the potential to impact socioeconomic resources include limits on accessibility to air and sea space within the Study Area, airborne acoustics, physical disturbances and strikes, and indirect impacts resulting from availability of resources (e.g., mineral resources and fisheries).

3.11.5.1 Combined Impacts of All Stressors under Alternative 1

Under Alternative 1, training and testing activities would be widely dispersed throughout the Study Area, limiting the potential for co-occurrence of stressors from multiple training or testing activities being conducted at the same time but in a different location. Certain training and testing activities may return to a specific geographic location to use its unique physical characteristics. Repeatedly using the same area may limit accessibility to that area for commercial or recreational activities relative to a less-frequently used area. The Navy typically uses established ranges, warning areas, and danger zones for training and testing activities that are conducted repeatedly over time. Many commercial and recreational users in the region are familiar with the locations of Navy activities, which allows for better planning and fewer instances of conflict. When an area needs to be temporarily closed to the public, the Navy notifies the public through Notices to Mariners and Notices to Airmen issued by the U.S. Coast Guard and the Federal Aviation Administration, respectively, ahead of time to avoid potential conflicts with the public. If multiple, incompatible training or testing activities need to use a specific location, the activities would not be scheduled at the same time, and stressors associated with each activity would not occur at the same time. Therefore, an increase in impacts resulting from a combination of stressors occurring simultaneously is not expected.

3.11.5.2 Combined Impacts of All Stressors under Alternative 2

The number and types of training and testing activities that would be conducted under Alternative 2 is similar to those described under Alternative 1 (see Chapter 2, Description of Proposed Action and Alternatives). Therefore, the combined impacts of all stressors under Alternative 2 would be the same as described under Alternative 1.

3.11.5.3 Combined Impacts of All Stressors under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Therefore, training and testing activities would not limit accessibility to air and sea space (although other Navy activities would still use established ranges, warning areas, and danger zones), generate airborne noise, or cause physical disturbances and strikes. No impacts on socioeconomic resources from these stressors would occur.

Ceasing the proposed training and testing activities may reduce the number and types of jobs available in locations where the Navy is a vital or even the primary economic driver sustaining local communities. For example, the use of munitions and other equipment used for training and testing activities would no longer be needed, and, consequently, the number of jobs supporting those industries may be reduced or, alternatively, some jobs may be relocated. The secondary effects from reducing personnel who support Navy training and testing activities could include a decline in local business and a decrease in the need for infrastructure, such as schools. If jobs are relocated, a smaller population may no longer be able to sustain the local economy that developed to support the larger population. While more complex studies at the local level would need to be conducted to quantify potential socioeconomic impacts from ceasing training and testing activities, it is highly likely that many coastal communities would be impacted to varying degrees.

This page intentionally left blank.

References

American Association of Port Authorities. (2017a). *Port Rankings by Tonnage 2016*. Washington, DC: U.S. Army Corps of Engineers, Waterborne Commerce Statistics Center.

American Association of Port Authorities. (2017b). *Port Cruise Traffic*. Alexandria, VA: American Association of Port Authorities.

Associated Oceans LLC. (2011). *Divespots*. Retrieved from divespots.com.

Bureau of Ocean Energy Management. (2011). *BOEM Gulf of Mexico OCS region blocks and active leases by planning area*. Washington, DC: U.S. Department of the Interior.

Bureau of Ocean Energy Management. (2013). *Smart from the Start*. Retrieved from http://www.boem.gov/Renewable-Energy-Program/Smart-from-the-Start/Index.aspx.

Bureau of Ocean Energy Management. (2014). *Atlantic Geological and Geophysical and Surveys: Record of Decision on the Programmatic Environmental Impact Statement*. Retrieved from http://www.boem.gov/Atlantic-GandG-ROD-Fact-Sheet/.

Bureau of Ocean Energy Management. (2015a). *BOEM Fact Sheet: BOEM's Renewable Energy Program*. Retrieved from http://www.boem.gov/BOEM-RE-Programs-Fact-Sheet/.

Bureau of Ocean Energy Management. (2015b). *Virginia Offshore Wind Technology Advancement Project (VOWTAP)*. Retrieved from http://www.boem.gov/Research-Nomination-Outside-and-to-the-West-of-the-WEADOE/.

Bureau of Ocean Energy Management. (2015c). *Marine Mineral Projects*. Retrieved from http://www.boem.gov/Marine-Mineral-Projects/.

Bureau of Ocean Energy Management. (2015d). *BOEM Fact Sheet: BOEM Response to Hurricane Sandy: Update on Recovery Assistance and Resilience Planning*. Retrieved from http://www.boem.gov/Fact-Sheet-Hurricane-Sandy/.

Bureau of Ocean Energy Management. (2016). *BOEM Gulf of Mexico OCS Region Blocks and Active Leases by Planning Area January 4, 2016*. Retrieved from http://www.boem.gov/Gulf-of-Mexico-Region-Lease-Map/.

Bureau of Ocean Energy Management. (2018). *Fact Sheet: BOEM's Renewable Energy Program*. Washington, DC: Office of Public Affairs.

Canada-Nova Scotia Offshore Petroleum Board. (2015). *SOEP Total Monthly Gas Production*. Retrieved from http://www.cnsopb.ns.ca/offshore-activity/offshore-projects/sable-offshore-energy-project.

Carlowicz, M. (2007). New regulations proposed for offshore fish farms: WHO-led task force recommended tough environmental standards. *Oceanus Magazine, 45*.

Coastal Scuba. (2007). *South Carolina Shipwrecks and Dive Site*. Retrieved from http://www.coastalscuba.com/sites.htm.

Deepwater Wind. (2018a). *Block Island Wind Farm: America's First Offshore Wind Farm*. Retrieved from http://dwwind.com/project/block-island-wind-farm/.

Deepwater Wind. (2018b). *America's First Offshore Wind Farm Powers Up*. Retrieved from http://dwwind.com/press/americas-first-offshore-wind-farm-powers/.

Dive Hatteras. (2003). *Shipwreck Diving Charters Dive Hatteras*. Retrieved from www.divehatteras.com.

Federal Energy Regulatory Commission. (2015). *Hydrokinetic Projects*. Retrieved from http://www.ferc.gov/industries/hydropower/gen-info/licensing/hydrokinetics.asp.

Federal Energy Regulatory Commission. (2018a). *Licensed Marine and Hydrokinetic Projects*. Washington, DC: U.S. Department of Energy.

Federal Energy Regulatory Commission. (2018b). *Active HydroKinetic Preliminary Permits*. Washington, DC: U.S. Department of Energy.

Hoyt, E. (2001). *Whale Watching 2001: Worldwide Tourism Numbers, Expenditures, and Expanding Socioeconomic Benefits*. Yarmouth Port, MA: International Fund for Animal Welfare.

International Maritime Organization. (2016). *Particularly Sensitive Sea Areas*. Retrieved from http://www.imo.org/en/OurWork/Environment/PSSAs/Pages/Default.aspx.

Kearney, B. (2003). *Foreign oysters not a quick fix for Chesapeake Bay, but aquaculture of sterile oysters may help*. Retrieved from http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=10796.

Maine Department of Marine Resources. (2012). *Maine Marine Aquaculture Harvest Data*. Retrieved from http://www.maine.gov/dmr/aquaculture/HarvestData.htm.

Marine World Database. (2009). *Bath*. Retrieved from http://www.anchorageworld.com/content/bath.

MarineEnergy.biz. (2017). *ORPC shows progress on Maine tidal project*. Retrieved from https://marineenergy.biz/2017/01/05/orpc-shows-progress-on-maine-tidal-project/.

Mintz, J. D. (2012). *Vessel Traffic in the Hawaii-Southern California and Atlantic Fleet Testing and Training Study Areas*. (CRM D0026186.A2/Final). Alexandria, VA: Center for Naval Analyses.

Monroe County Tourist Development Council. (2010). *Florida Keys Fishing Tournaments & Calendar of Events*. Retrieved from http://www.fla-keys.com/tdcfishingcalendar.cfm.

Morse, D., and M. Pietrak. (2009). *Aquaculture Situation and Outlook Report 2009: Maine*. (NRAC Publication No. 105-2009). College Park, MD: Northeastern Regional Aquaculture Center.

Murray, T. J., and M. J. Oesterling. (2009). *Virginia Shellfish Aquaculture Situation and Outlook Report*. (VSG-09-04 VIMS Marine Resource Report No. 2009-5). Gloucester Point, VA: Virginia Sea Grant Marine Extension Program and Virginia Institute of Marine Science.

National Marine Fisheries Service. (2015a). *Fisheries Economics of the United States, 2013*. (NOAA Technical Memorandum NMFS-SPO-159). Silver Spring, MD: U.S. Department of Commerce.

National Marine Fisheries Service. (2015b). *Fisheries of the United States 2014*. (NOAA Current Fishery Statistics No. 2014). Retrieved from https://www.st.nmfs.noaa.gov/commercial-fisheries/fus/fus14/index.

National Marine Fisheries Service. (2015c). *Annual Commercial Landing Statistics*. Retrieved from https://www.st.nmfs.noaa.gov/commercial-fisheries/commercial-landings/annual-landings/index.

National Marine Fisheries Service. (2016a). *Fisheries of the United States*. Silver Spring, MD: Fisheries Statistics Division.

National Marine Fisheries Service. (2016b). *Fisheries Economics of the United States, 2014*. Silver Spring, MD: U.S. Department of Commerce, NOAA Technical Memorandum National Marine Fisheries Service-F/SPO-163.

National Marine Fisheries Service. (2017). *Fisheries of the United States 2016*. Silver Spring, MD: Office of Science and Technology.

National Marine Fisheries Service. (2018a). *Atlantic and Gulf Commercial Fisheries Landings 2016*. Retrieved from https://www.st.nmfs.noaa.gov/commercial-fisheries/commercial-landings/annual-landings/index.

National Marine Fisheries Service. (2018b). *Recreational Fisheries Statistics Queries*. Retrieved from http://www.st.nmfs.noaa.gov/st1/recreational/queries/.

National Ocean Economics Program. (2015a). *State of the U.S. Ocean and Coastal Economies 2014*. Retrieved from http://www.oceaneconomics.org/Minerals/OGdataSearch.aspx.

National Ocean Economics Program. (2015b). *Market Data*. Retrieved from http://www.oceaneconomics.org/Market/ocean/oceanEcon.asp?IC=N&dataSource=E.

National Oceanic and Atmospheric Administration. (1998). *Year of the Ocean, Coastal Tourism and Recreation*. Washington, DC: United States Department of Commerce.

National Oceanic and Atmospheric Administration. (2005). *Florida Keys National Marine Sancutary Draft Revised Management Plan*. Marathon, FL: U.S. Department of Commerce.

National Oceanic and Atmospheric Administration. (2007a). *Recipients of the 2007 NOAA National Marine Aquaculture Initiative Grants*. Retrieved from http://www.nmfs.noaa.gov/aquaculture/funding/nmai.html.

National Oceanic and Atmospheric Administration. (2007b). *Project Descriptions: 2007 National Marine Aquaculture Initiative grant awards*. Retrieved from https://seagrant.noaa.gov/Our-Work/Aquaculture.

National Oceanic and Atmospheric Administration. (2010). *Stellwagen Bank National Marine Sanctuary Final Management Plan and Environmental Assessment*. Silver Spring, MD: National Ocean Service, Office of National Marine Sanctuaries. Retrieved from http://stellwagen.noaa.gov/management/fmp/fmp2010.html.

National Oceanic and Atmospheric Administration. (2014). *Gray's Reef National Marine Sanctuary: Visiting Your Sanctuary*. Retrieved from http://graysreef.noaa.gov/visit/welcome.html.

National Oceanic and Atmospheric Administration. (2015a). *Monitor National Marine Sanctuary: About Your Sanctuary*. Retrieved from http://monitor.noaa.gov/about/.

National Oceanic and Atmospheric Administration. (2015b). *Gray's Reef National Marine Sanctuary: About Your Sanctuary*. Retrieved from http://graysreef.noaa.gov/about/welcome.html.

National Oceanic and Atmospheric Administration. (2016a). *About the National Marine Aquaculture Initiative*. Retrieved from http://www.nmfs.noaa.gov/aquaculture/funding/nmai.html.

National Oceanic and Atmospheric Administration. (2016b). *Flower Garden Banks: About Your Sanctuary*. Retrieved from http://flowergarden.noaa.gov/visiting/visit.html.

North Carolina Wildlife Resources Commission. (2016). *Boating Access Areas*. Retrieved from http://www.ncwildlife.org/Boating/WheretoBoat.aspx.

Nova Scotia Canada. (2015). *Georges Bank Moratorium Extended to 2022*. Retrieved from http://novascotia.ca/news/release/?id=20151126001.

Port Canaveral. (2016). *Port Cruise Facts*. Retrieved from //www.portcanaveral.com/Cruise/Port-Cruise-Facts.

Post, M. B. (2018). Bill to restart Fishermen's Energy offshore wind farm advances. *Wind Watch*. Retrieved from https://www.wind-watch.org/news/2018/03/23/bill-to-restart-fishermens-energy-offshore-wind-farm-advances/.

Professional Association of Diving Instructors. (2011). *Scuba Certification Frequently Asked Questions*. Retrieved from http://www.padi.com/scuba/scuba-diving-guide/start-scuba-diving/scuba-certification-faq/default.aspx.

Rice, M. R., and D. Leavitt. (2009). *Aquaculture Situation and Outlook Report 2009: Rhode Island*. College Park, MD: University of Maryland.

Roberts, J. J. (2007). Florida Keys National Marine Sanctuary. *In Marine Environment Protection and Biodiversity Conservation: The Application and Future Development of the IMO's Particularly Sensitive Sea Area Concept* (pp. 166–171). New York, NY: Springer-Verlag Berlin Heidelberg.

Southwick Associates. (2013). *Comparing NOAA's Recreational and Commercial Fishing Economic Data* (Produced for the American Sportfishing Association). Fernandina Beach, FL: Southwick Associates.

Thomas, R. (2011). *Wreck diving in North Carolina*. *USA Today Travel Tips Demand Media.* Retrieved from http://traveltips.usatoday.com/wreck-diving-north-carolina-2564.html.

U.S. Army Corps of Engineers. (2016). *U.S. Port Rankings by Cargo Tonnage in 2014*. Retrieved from http://www.navigationdatacenter.us/data/datappor.htm.

U.S. Army Corps of Engineers. (2017). *U.S. Port Rankings by Cargo Tonnage in 2016*. Retrieved from http://www.navigationdatacenter.us/data/datappor.htm.

U.S. Coast Guard. (2017). *2016 Recreational Boating Statistics*. Washington, DC: Office of Auxiliary and Boating Safety.

U.S. Department of Agriculture. (2014). *Census of Aquaculture (2013)*. (AC-12-SS-2). Retrieved from http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Aquaculture/.

U.S. Department of Energy, and U.S. Department of the Interior. (2011). *A National Offshore Wind Strategy: Creating an Offshore Wind Energy Industry in the United States*. Washington, DC: U.S. Department of Energy. Retrieved from https://www1.eere.energy.gov/wind/pdfs/national_offshore_wind_strategy.pdf.

U.S. Department of Energy. (2015a). *Marine and Hydrokinetic Energy Research and Development*. Retrieved from http://energy.gov/eere/water/marine-and-hydrokinetic-energy-research-development.

U.S. Department of Energy. (2015b). *U.S. Department of Energy Wind and Water Power Technologies Office Funding in the United States: Marine and Hydrokinetic Energy Products*. Washington, DC: U.S. Department of Energy. Retrieved from http://energy.gov/sites/prod/files/2015/04/f22/MHK-Project-Report-4-14-15.pdf.

U.S. Department of Energy. (2017). *How Do Turbines Work?* , Retrieved from https://www.energy.gov/eere/wind/how-do-wind-turbines-work.

U.S. Department of the Navy. (2005). *Overseas Environmental Assessment of Testing the Hellfire Missile System's Integration with the H-60 Helicopter*. Washington, DC: Naval Air Systems Command.

U.S. Department of the Navy. (2007). *Airspace Procedures and Planning Manual* (OPNAVINST 370.2J). Washington, DC: U.S. Department of the Navy.

U.S. Department of the Navy. (2008). *Test and Safety Planning*. (NSWC PCD Instruction 5100.30D).

U.S. Department of the Navy. (2009). *Narragansett Bay Shallow Water Test Facility*. Retrieved from https://www.fbo.gov/?s=opportunity&mode=form&tab=core&id=5fbacfbaa49a922882285d9b3bf3eef7&_cview=1.

U.S. Department of the Navy. (2010). *USDA, Navy Sign Agreement to Encourage the Development, Use of Renewable Energy*. Retrieved from http://www.navy.mil/search/display.asp?story_id=50710.

U.S. Department of the Navy. (2013). *Key West Range Complex Management Plan (RCMP)*. (No. N62470-02-D-xxxx). Washington, DC: U.S. Fleet Forces Command and Naval Facilities Engineering Command.

U.S. Department of the Navy. (2015). *Manual for the Utilization of Fleet Area Control and Surveillance Facility, Virginia Capes Operations Areas*. (FACSFACVACAPESINST 3120.1N). Virginia Beach, VA: Department of the Navy.

U.S. Department of the Navy. (2016). *NATOPS General Flight and Operating Instructions; OPNAV Instruction 3710.7V*. Washington, DC: Office of the Chief of Naval Operations.

U.S. Maritime Administration. (2015). *U.S. Waterborne Foreign Container Trade by U.S. Customs Ports (2000–2015)*. Washington, DC: U.S. Department of Transportation.

U.S. Maritime Administration. (2016). *2015 Vessel Calls in U.S. Ports, Selected Terminals and Lightering Areas*. Retrieved from http://www.marad.dot.gov/resources/data-statistics/#Reports.

University of New Hampshire. (2016). *Atlantic Marine Aquaculture Center* Retrieved from http://marine.unh.edu/program/atlantic-marine-aquaculture-center.

Webster, D., D. Merritt, J. Takacs, T. Rippen, A. Lazur, D. Telizzi, and R. Harrell. (2009). *Aquaculture Situation and Outlook Report 2009: Maryland*. College Park, MD: University of Maryland.

This page intentionally left blank.

Final
Environmental Impact Statement/Overseas Environmental Impact Statement
Atlantic Fleet Training and Testing

TABLE OF CONTENTS

List of Figures

This section does not contain figures.

List of Tables

This section does not contain tables.

This page intentionally left blank.

3.12 Public Health and Safety

PUBLIC HEALTH AND SAFETY SYNOPSIS

The United States Department of the Navy considered all potential stressors that public health and safety could potentially be exposed to from the Proposed Action. The following conclusions have been reached for the Preferred Alternative (Alternative 1):

- In-Water Energy: Because of the Navy's standard operating procedures, impacts on public health and safety would be unlikely.
- In-Air Energy: Because of the Navy's standard operating procedures, impacts on public health and safety would be unlikely.
- Physical Interactions: Because of the Navy's standard operating procedures, impacts on public health and safety would be unlikely.
- Secondary Stressors (sediments and water quality): Because water and sediment quality impacts would be minimal and temporary and the Navy would not exceed state or federal water quality standards, impacts on public health and safety would be unlikely.

3.12.1 Introduction

This section provides the analysis of potential impacts on public health and safety within the Atlantic Fleet Training and Testing (AFTT) Study Area.

The affected environment provides the context for evaluating the effects of the Navy training and testing on public health and safety. Generally, the greatest potential for a proposed activity to impact the public is in nearshore areas because that is where public activities are most concentrated. Proposed training and testing in nearshore areas could be close to dive sites and other recreational areas where the collective health and safety of groups of individuals would be of concern. Most commercial and recreational marine activities (with the exception of commercial shipping) occur close to the shore, usually limited by the capabilities of the vessel or equipment used.

The Navy employs standard operating procedures to provide for the safety of personnel and equipment as well as the success of the training and testing activities. Standard operating procedures designed to prevent public health and safety impacts are discussed in detail in Section 2.3.3 (Standard Operating Procedures). The following subsections discuss established safety protocols and standard operating procedures associated with the sea space and airspace environment, as well as specific procedures associated with aviation safety, submarine navigation safety, surface vessel navigation safety, sonar safety, electromagnetic energy safety, and munitions safety.

Methods

The requirements for public health and safety were derived from federal regulations, Department of Defense (DoD) directives, and Navy instructions for training and testing. The directives and instructions provide specifications for mission planning and execution, including criteria for public health and safety considerations.

The alternatives were evaluated based on two factors: the potential for specific training or testing activities to impact public health and safety and the degree to which those activities could have an impact. The likelihood that members of the public would be near a training or testing activity determined the potential for exposure to the activity. If the potential for exposure existed, the degree of the potential impacts on public health and safety, including increased risk for injury or loss of life, was determined. If the potential for exposure did not exist, it was determined that there would be no impacts on public health and safety.

3.12.2 Affected Environment

3.12.2.1 General Background

The Study Area is shared by military, commercial, institutional, and recreational users. The Navy is committed to ensuring public safety during training and testing activities. To protect public safety, access to certain ocean areas must be temporarily limited during certain training and testing activities.

The area of interest for assessing potential impacts on public health and safety is the U.S. territorial waters of the east and Gulf coasts (seaward of the mean high water line to 12 nautical miles [NM]), including bays, harbors, and inshore waterways of the east coast where training and testing occur. Military, commercial, institutional, and recreational activities take place simultaneously in the Study Area and have coexisted safely for decades. These activities coexist safely because established rules and practices lead to safe use of the waterways and airspace. The following paragraphs briefly discuss the rules and practices for recreational, commercial, and military use in sea surface areas and airspace.

3.12.2.1.1 Sea Space

Most of the sea space in the Study Area is accessible for recreational and commercial activities; however, some activities are prohibited or restricted in certain areas (e.g., danger zones and restricted areas).

In accordance with Title 33 Code of Federal Regulations (CFR) part 165 (Regulated Navigation Areas and Limited Access Areas), these restrictions can be permanent or temporary. Nautical charts issued by the National Oceanic and Atmospheric Administration include these federally designated zones and areas. Operators of recreational and commercial vessels have a duty to abide by maritime regulations administered by the U.S. Coast Guard.

In accordance with 33 CFR part 72 (Aids to Navigation), the U.S. Coast Guard informs private and commercial vessels about temporary closures via Notices to Mariners. These notices provide information about durations and locations of closures because of activities that are potentially hazardous to surface vessels. Broadcast notices on maritime frequency radio, weekly publications by the appropriate U.S. Coast Guard Navigation Center, and global positioning system navigation charts disseminate these navigational warnings.

3.12.2.1.2 Airspace

Most of the airspace in the Study Area is accessible to general aviation (recreational, private, corporate) and commercial aircraft; however, like waterways, some areas are temporarily off-limits to civilian and commercial use. The Federal Aviation Administration has established special use airspace, which is airspace of defined dimensions wherein activities must be confined because of their nature or wherein limitations may be imposed upon aircraft operations that are not part of those activities (Federal Aviation Administration Order 7400.2L, *Procedures for Handling Airspace Matters*, *Special Use Airspace*, Part 5, Chapters 21 to 28, effective April 27, 2017). Special use airspace in the Study Area includes the following:

- Restricted airspace: Areas where aircraft are subject to restriction due to the existence of unusual (often invisible) hazards to aircraft (e.g., release of munitions). Some areas are under strict control of DoD, and some are shared with non-military agencies (Federal Aviation Administration Order 7400.2L, Chapter 23).
- Military Operations Areas: Airspace designated outside of Class A airspace to separate or segregate certain non-hazardous military activities from Instrument Flight Rules traffic and identify for Visual Flight Rules traffic where these activities are conducted (Federal Aviation Administration Order 7400.2L, Chapter 25).
- Warning areas: Areas of defined dimensions, extending from 3 NM outward from the coast of the United States, that serve to warn non-participating aircraft of potential danger (Federal Aviation Administration Order 7400.2L, Chapter 24).

Additionally, Air Traffic Control Assigned Airspace is airspace with defined vertical/lateral limits, implemented by Letter of Agreement between the user and the concerned an Air Route Traffic Control Center, and assigned by Air Traffic Control for the purpose of providing air traffic segregation between the specified activity being conducted within the assigned airspace and other Instrument Flight Rules traffic. Air Traffic Control Assigned Airspace should not be established to contain activities for which a specific type of special use airspace should be designated (i.e., should not be used as a substitute for a more appropriate special use airspace designation).

Notices to Airmen are created and transmitted by government agencies and airport operators to alert aircraft pilots of any hazards en route to or at a specific location. Notices to Airmen contain information (not known sufficiently in advance to publicize by other means) concerning the establishment, condition, or change in any component (facility, service, procedure, or hazard in the National Airspace System) the timely knowledge of which is essential to personnel concerned with flight operations. The Federal Aviation Administration issues Notices to Airmen to disseminate information on upcoming or ongoing military exercises with resulting airspace restrictions. Civilian aircraft operators are responsible for being aware of restricted areas in airspace and any Notices to Airmen in effect. Pilots have a duty to abide by aviation rules as administered by the Federal Aviation Administration.

Weather conditions dictate whether an aircraft (general aviation, commercial, or military) can fly under Visual Flight Rules or Instrument Flight Rules. Under Visual Flight Rules, the weather is favorable and the pilot is required to remain clear of clouds by specified distances to ensure separation from other aircraft under the concept of "see and avoid." Pilots flying under Visual Flight Rules must be able to see outside of the cockpit, control the aircraft's attitude, navigate, and avoid obstacles and other aircraft based on visual cues. Pilots flying under Visual Flight Rules assume responsibility for their separation from all other aircraft and are generally not assigned routes or altitudes by air traffic control.

During unfavorable weather, pilots must follow Instrument Flight Rules. Factors such as visibility, cloud distance, cloud ceilings, and weather phenomena cause visual conditions to drop below the minimum required to operate by visual flight referencing. Instrument Flight Rules are the regulations and restrictions a pilot must comply with when flying in weather conditions that restrict visibility. Pilots can fly under Instrument Flight Rules in Visual Flight Rules weather conditions; however, pilots cannot fly under Visual Flight Rules in Instrument Flight Rules weather conditions.

3.12.2.2 Safety and Inspection Procedures

In accordance with Navy instructions presented in this chapter, safety and inspection procedures discussed in this section are designed to ensure public health and safety. Through the Naval Safety Center and Fleet Safety Center, the Navy promotes a proactive and comprehensive safety program designed to reduce, to the greatest extent possible, any potential adverse impacts on public health and safety from training and testing activities.

As previously stated, the greatest potential for training or testing activities to impact the public is in nearshore areas, because public activities are concentrated in those areas. When planning a training or testing activity, the Navy considers proximity of the activity to public areas in choosing a location. Important factors considered include the ability to control access to an area; schedule (time of day, day of week); frequency, duration, and intensity of activities; range safety procedures; operational control of activities; and safety history.

The Navy's Fleet Area Control and Surveillance Facilities provide support and training resources for DoD, Homeland Defense, and foreign military units by coordinating, scheduling, and monitoring activities in U.S. Fleet Forces Command operating areas and special use airspace. At Navy ranges, Range Control is responsible for hazard area surveillance and clearance and the control of all range operational areas. Although operations in special use airspace are scheduled through the Navy Fleet Area Control and Surveillance Facilities, Range Control coordinates the real-time control of ranges in coordination with the Federal Aviation Administration and other military users and communicates with the operations conductors and all participants entering and leaving the range areas. The Federal Aviation Administration and the U.S. Coast Guard issue Notices to Airmen and Notices to Mariners, respectively.

During training and testing activities in the Study Area, the Navy ensures that the appropriate safety zone is clear of non-participants before engaging in certain activities, such as weapon firing. Inability to obtain a "clear range" could result in the delay, cancellation, or relocation of an event. This approach ensures public safety during Navy activities that otherwise could harm non-participants. Current Navy practices employ the use of sensors and other devices (e.g., radar and big-eye binoculars) to ensure public health and safety while conducting training and testing activities. The following subsections outline the current requirements and practices for human safety as they pertain to range safety procedures, range inspection procedures, exercise planning, and scheduling and coordinating procedures for the Navy.

Training activities must comply with Fleet Area Control and Surveillance Facility procedures. Fleet Area Control and Surveillance Facilities, Virginia Capes and Jacksonville, have published safety procedures for activities conducted both nearshore and offshore (U.S. Department of the Navy, 2011a). These guidelines (and others) apply to range users as follows:

- Navy personnel are responsible for ensuring that impact areas and targets are clear before commencing hazardous activities.
- The use of in-water munitions must be coordinated with submarine operational authorities. The coordination also applies to towed sound navigation and ranging (sonar) arrays and torpedo countermeasures.
- Aircraft or vessels expending munitions shall not commence firing without the permission of the Range Safety Officer for their specific range area.
- Firing units and targets must remain in their assigned areas, and units must fire in accordance with current safety instructions.

- Aircraft carrying munitions to or from ranges shall avoid populated areas to the maximum extent possible.
- Strict on-scene procedures include the use of ship sensors, visual surveillance of the range from aircraft and range safety boats, and radar and acoustic data to confirm the firing range and target area are clear of civilian vessels, aircraft, or other non-participants.

Comprehensive safety planning instructions exist for specific testing activities, such as laser and electromagnetic energy testing (U.S. Department of the Navy, 2009). These instructions provide guidance on how to identify the hazards, assess the potential risk, analyze risk control measures, implement risk controls, and review safety procedures. They apply to all testing activities, including ground, waterborne, and airborne testing activities involving personnel, aircraft, inert minefields, equipment, and airspace. The guidance applies to system program managers, program engineers, test engineers, test directors, and aircrews that are responsible for incorporating safety planning and review when conducting test programs.

3.12.2.2.1 Aviation Safety

The Navy procedures regarding planning and management of special use airspace are provided in the Chief of Naval Operations Instruction 3770.2L, *Airspace Procedures and Planning Manual* (U.S. Department of the Navy, 2007).

Scheduling and planning procedures for air operations on range complexes (including testing activities in the Northeast Range Complexes) are issued through the Navy's Fleet Area Control and Surveillance Facility, Virginia Capes (U.S. Department of the Navy, 2015a).

Testing activities have their own procedures that require that safety be considered in any testing event. For example, the Navy's Operational Test Director's Manual prescribes policies and procedures for the planning, conduct, and reporting of Operational Test and Evaluation of new and improved naval weapons and warfare support systems (U.S. Department of the Navy, 2016).

Aircrews involved in training or testing exercises must be aware that non-participating aircraft and ships are not precluded from entering the area and may not comply with Notices to Airmen or Notices to Mariners. Aircrews are required to maintain a continuous lookout for non-participating aircraft while operating in warning areas under Visual Flight Rules. In general, aircraft carrying munitions are not allowed to fly over public or commercial boats or ships.

3.12.2.2.2 Submarine Navigation Safety

Submarine crews use various methods to avoid collisions while they are surfaced, including visual and radar scanning, acoustic depth finders, and state-of-the-art satellite navigational systems. During submerged transit, submarines use all available ocean navigation tools, including inertial navigation charts that calculate position based on the submerged movements of the submarine. Submarines use these systems to avoid surface vessels as well as all other hazards to navigation.

3.12.2.2.3 Surface Vessel Navigation Safety

The Navy practices the fundamentals of safe navigation. As specified in Section 2.3.3 (Standard Operating Procedures), ships operated by or for the Navy have personnel assigned to stand watch at all times, day and night, when underway. Watch personnel undertake extensive training in accordance with the *Navy Lookout Training Handbook* or civilian equivalent, including on-the-job instruction and a formal Personal Qualification Standard program (or equivalent program for supporting contractors or civilians), to certify that they have demonstrated all necessary skills (such as detection and reporting of floating or partially submerged objects). While on watch, personnel employ visual search techniques, including the use of binoculars and scanning techniques in accordance with the *Navy Lookout Training Handbook* or civilian equivalent. After sunset and prior to sunrise, watch personnel employ night visual search techniques, which could include the use of night vision devices. Watch personnel are primarily posted for safety of navigation, range clearance, and man-overboard precautions. For some specific testing activities, such as unmanned surface vehicle testing, a support boat would be used in the vicinity of the test to ensure safe navigation. Before firing or launching a weapon or radiating a non-eye-safe laser, Navy surface vessels are required to determine that all safety criteria have been satisfied. When applicable, the surface vessel would use aircraft and other boats to aid in navigation.

3.12.2.2.4 Sonar Safety

Surface vessels and submarines may use active sonar in the pierside locations listed in Chapter 2 (Description of Proposed Action and Alternatives) and during transit to training or testing exercise locations. To ensure safe and effective sonar use, the Navy applies the same safety procedures for pierside sonar use as described under Section 3.12.2.2 (Safety and Inspection Procedures).

The U.S. Navy Diving Manual, Appendix 1A, *Safe Diving Distances from Transmitting Sonar*, is the Navy's governing document for protecting divers during active sonar use (U.S. Department of the Navy, 2011b). The manual provides procedures for calculating safe distances from active sonar. These procedures are derived from experimental and theoretical research conducted at the Naval Submarine Medical Research Laboratory and the Navy Experimental Diving Unit. Safety distances vary based on conditions that include diver dress, type of sonar, and duration of time in the water. These safety distances would also be applicable to recreational swimmers and divers. Some safety procedures include measurements to be taken during testing activities to identify an exclusion area for non-participating swimmers and divers.

3.12.2.2.5 Electromagnetic Energy Safety

This section discusses electromagnetic energy transmitted through the air as a result of proposed activities. All frequencies (or wavelengths) of electromagnetic energy are referred to as the *electromagnetic spectrum* and include electromagnetic energy and radio frequency radiation. Communications and electronic devices such as radar, electronic warfare devices, navigational aids, two-way radios, cell phones, and other radio transmitters produce electromagnetic radiation. While such equipment emits electromagnetic energy, some of these systems are the same as, or similar to, civilian navigational aids and radars at local airports and television weather stations. Radio waves and microwaves emitted by transmitting antennas are another form of electromagnetic energy, collectively referred to as radio frequency radiation. Radio frequency energy includes frequencies ranging from 0 to 3,000 gigahertz. Exposure to radio frequency energy of sufficient intensity at frequencies between 3 kilohertz and 300 gigahertz can adversely affect people, munitions, and fuel.

To avoid excessive exposures from electromagnetic energy, military aircraft are operated in accordance with standard operating procedures that establish minimum separation distances between electromagnetic energy emitters and people, munitions, and fuels (U.S. Department of Defense, 2009). Thresholds for determining hazardous levels of electromagnetic energy to humans, munitions, and fuel have been determined for electromagnetic energy sources based on frequency and power output, and practices are in place to protect the public from electromagnetic radiation hazards (U.S. Department of Defense, 2002, 2009). These procedures include setting the heights and angles of electromagnetic energy transmissions to avoid direct exposure, posting warning signs, establishing safe operating levels, activating warning lights when radar systems are operational, and not operating some platforms that emit electromagnetic energy within 15 NM of shore. Safety planning instructions provide clearance procedures for non-participants in operational areas before conducting training and testing activities that involve in-water electromagnetic energy (e.g., mine warfare) (U.S. Department of the Navy, 2008a, 2009, 2015a).

3.12.2.2.6 Laser Safety

Lasers produce a coherent beam of light energy. The Navy uses lasers for precision range finding, as target designation/illumination devices for engagement with laser-guided weapons, and for mine detection and mine countermeasures, as well as for non-lethal deterrents. Testing activities include high-energy laser weapons tests to evaluate the specifications, integration, and performance of a vessel- or aircraft-mounted, high-energy laser. The high-energy laser would be used as a weapon to disable small surface vessels. Office of the Chief of Naval Operations Instruction 5100.27B/Marine Corps Order 5104.1C, *Navy Laser Hazards Control Program*, prescribes Navy and Marine Corps policy and guidance in the identification and control of laser hazards. The Navy observes strict precautions and has written instructions in place for laser users to ensure that non-participants are not exposed to intense light energy. Laser safety procedures for aircraft require an initial pass over the target before laser activation to ensure that target areas are clear. During actual laser use, aircraft run-in headings are also restricted to avoid unintentional contact with personnel or non-participants. Personnel participating in laser training activities are required to complete an annual laser safety course (U.S. Department of the Navy, 2008b).

3.12.2.2.7 Explosive Munitions Detonation Safety

Pressure waves from in-water detonations can pose a physical hazard in surrounding waters. Before conducting an in-water explosive training or testing activity, Navy personnel establish an appropriately sized exclusion zone to avoid exposing non-participants to the harmful intensities of pressure waves. The U.S. Navy Diving Manual, Section 2.7, *Underwater Explosions*, provides procedures for determining safe distances from in-water explosions (U.S. Department of the Navy, 2011b). In accordance with training and testing procedures for safety planning related to detonations (Section 3.12.2.2.8, Weapons Firing and Munitions Expenditure Safety), the Navy uses the following detonation procedures:

- Navy personnel are responsible for ensuring that impact areas and targets are clear before commencing hazardous activities.
- The use of in-water munitions must be coordinated with submarine operational authorities.
- Aircraft or vessels expending munitions shall not commence firing without permission of the Range Safety Officer or Test Safety Officer for their specific range area.
- Firing units and targets must remain in their assigned areas, and units must fire in accordance with current safety instructions.
- Detonation activities would be conducted during daylight hours.

3.12.2.2.8 Weapons Firing and Munitions Expenditure Safety

Navy explosives safety policy is based on the requirements of DoD 6055.9-STD, *Ammunition and Explosives Safety Standards*. This DoD standard establishes uniform safety requirements applicable to ammunition and explosives and to associated and unrelated personnel and property exposed to the potentially damaging effects of an accident involving ammunition and explosives during, among other things, usage during training, testing, transportation, handling, storage, maintenance, and disposal (U.S. Department of Defense, 2012).

Safety is a primary consideration for all training and testing activities. The range must be able to safely contain the hazard area of the weapons and equipment employed. The hazard area is based on the size and net explosive weight of the weapon, and it includes a safety buffer around the target to account for items going off-range or malfunctioning. The size of the buffer zone is determined by the type of activity. For activities with a large hazard area, special sea and air surveillance measures are implemented to make sure the area is clear before the activities commence. Before aircraft can drop munitions, they are required to make a preliminary pass over the intended target area to ensure that it is clear of boats, divers, or other non-participants. Aircraft carrying munitions are not allowed to fly over surface vessels.

Training and testing activities are delayed, moved, or cancelled if there is a question about the safety of the public. Target areas must be clear of non-participants before conducting training and testing. When using munitions with flight termination systems (which terminate the flight of airborne missiles or launch vehicles when they veer from their targeted path), the Navy is required to follow standard operating procedures to ensure public health and safety. In those cases where a weapons system does not have a flight termination system, the size of the target area that needs to be clear of non-participants is based on the flight distance of the weapon plus an additional distance beyond the system's performance capability.

3.12.3 Environmental Consequences

This section evaluates how and to what degree the activities described in Chapter 2 (Description of Proposed Action and Alternatives) would potentially impact public health and safety. Table 2.6-1 (Proposed Training Activities per Alternative) through Table 2.6-4 (Office of Naval Research Proposed Testing Activities per Alternative) present the existing and proposed training and testing activity locations for each alternative (including the annual number of events). Each public health and safety stressor is introduced, and analyzed by alternative for both training and testing activities. Tables B-1 (Stressors by Training Activity) and B-2 (Stressors by Testing Activity) in Appendix B (Activity Stressor Matrices) show the warfare areas and associated stressors that were considered for analysis of public health and safety. The stressors vary in intensity, frequency, duration, and location within the Study Area. The stressors applicable to public health and safety are the following:

- **In-water energy** (sonar and in-water explosions)
- **In-air energy** (radar and lasers)
- **Physical interactions** (aircraft, vessels, in-water devices/targets, munitions, seafloor devices)
- **Secondary stressors** (impacts to water quality from explosives and explosive byproducts, metals, chemicals other than explosives, and other materials)

As discussed in Chapter 2 (Description of Proposed Action and Alternatives), the majority of the training and testing activities that would be conducted under Alternatives 1 and 2 are the same as or similar to those currently being conducted or that have been conducted in the past.

The potential for impacts on public health and safety were evaluated assuming the implementation of the Navy's standard operating procedures, as discussed in Section 2.3.3 (Standard Operating Procedures). Training and testing activities in the Study Area are conducted in accordance with guidance provided in Fleet Area Control and Surveillance Facility Instructions (U.S. Department of the Navy, 2015a, 2015b) and/or Test and Safety Planning Instructions (U.S. Department of the Navy, 2009). These instructions provide standard operating procedures for all range events. They also provide users with information that is necessary to operate safely and avoid affecting non-military activities such as shipping, recreational boating, diving, and commercial or recreational fishing. Ranges are managed in accordance with standard operating procedures that ensure public health and safety.

3.12.3.1 In-Water Energy

In-water energy can come from acoustic sources or electromagnetic devices. Active sonar, in-water explosions, air guns, and vessel movements produce in-water acoustic energy. Sound travels from air to water during aircraft overflights. Electromagnetic energy can enter the water from mine warfare training devices and unmanned underwater vehicles. The potential for the public to be exposed to these stressors would be limited to individuals such as recreational swimmers or scuba divers who are underwater and within unsafe proximity of a training or testing event.

In-water acoustic energy is generated from many of the proposed activities; however, not all would be considered in detail in this environmental impact statement/overseas environmental impact statement (EIS/OEIS) in terms of their impact on public health and safety because the public safety risks from some activities are deemed to be negligible. The public might intermittently hear noise from ships if they are in the general vicinity of a training or testing event, but there would be no impact on public health and safety because of the infrequency and short duration of events. In addition, air guns are used during some pierside integrated swimmer defense training and testing activities, but public health and safety would not be put at risk because access to pierside locations by non-participants is controlled. Active sonar and in-water explosions are the only sources of in-water acoustic energy evaluated for potential impacts on public health and safety.

The proposed activities that would result in in-water acoustic energy include activities such as amphibious warfare, surface warfare, anti-submarine warfare, mine warfare, surface warfare testing, sonar maintenance, pierside sonar testing, and unmanned underwater vehicle testing. A limited amount of active sonar would be used during transit between range complexes and training and testing locations.

The effect of active sonar on humans varies with the frequency of sonar involved. Of the four types of sonar (very high-, high-, mid-, and low-frequency), mid-frequency and low-frequency sonar have the greatest potential to impact humans due to the range of human hearing capabilities.

In-water explosives cause a physical shock front that compresses the explosive material, and a pressure wave that passes into the surrounding water. Generally, the pressure wave would be the primary cause of injury. The effects of an in-water explosion depend on several factors, including the size, type, and depth of the explosive charge and where it is in the water column.

Electromagnetic energy is associated with systems such as the Organic Airborne and Surface Influence Sweep System that emit an electromagnetic field to simulate the presence of a ship. Electromagnetic energy can also be used in a defensive mode to cause nearby mines to explode. Unmanned underwater vehicles, some unmanned surface vehicles, and towed devices use electromagnetic energy, either for navigation or as a means to be targeted.

Electromagnetic energy dissipates quickly with distance from the source. Scientific literature does not conclude that there are adverse health effects from most levels of electromagnetic energy, which is why no federal standards have been set for occupational exposures to this type of energy. DoD Instruction

3222.03 provides guidance regarding management and implementation of the electromagnetic environmental effects program, including hazards of electromagnetic radiation to personnel (U.S. Department of Defense, 2015).

As previously stated, the potential for the public to be exposed to these stressors would be limited to individuals who are underwater and within unsafe proximity to an event. Scuba diving is a popular recreational activity that is typically concentrated around known dive attractions, such as reefs and shipwrecks. The Professional Association of Diving Instructors (one of several scuba diving instruction organizations) suggests that no recreational diver should exceed 130 feet (ft.) of depth (Professional Association of Diving Instructors, 2011). These depths typically limit this activity's distance from shore.

Navy operations overlapping with recreational swimmers or divers would be unlikely. Recreational swimmers and divers are not precluded from operating in public boat lanes or adjoining areas near Navy pierside locations (which include shipyards); however, Navy operators are diligent in identifying recreational swimmers and divers to ensure that these would be avoided. Additionally, recreational divers would not be expected near Navy ships at sea. The locations of popular offshore diving spots are well-documented, and dive boats (typically well-marked) and diver-down flags would be visible from the ships conducting the training and testing. The U.S. Navy Diving Manual (U.S. Department of the Navy, 2011b) contains methodologies to determine appropriate safety distances associated with sonar use near Navy divers. These safety distances would also be used as safety buffers to protect public health and safety. If any unauthorized personnel are detected within the sonar activity safety buffer, the activity would be temporarily halted until the area is again cleared.

3.12.3.1.1 Impacts from In-Water Energy Under Alternative 1

Impacts from In-Water Energy Under Alternative 1 for Training Activities

Under Alternative 1, the Navy would conduct active sonar training activities such as anti-submarine warfare, mine warfare, and sonar maintenance in the Northeast, Virginia Capes, Navy Cherry Point, Jacksonville, and Gulf of Mexico Range Complexes. Activities involving in-water explosions, such as surface warfare and mine warfare, would be conducted at established ranges and training locations. The Navy would conduct these activities throughout the Study Area.

As previously discussed, the Navy implements operating procedures designed to protect public health and safety. These procedures include the following:

- ensuring that training areas are clear before commencing hazardous activities
- conducting all activities in accordance with established safety instructions
- conducting in-water detonations only at established and approved locations
- posting Navy Lookouts at all times during an exercise to ensure non-participants do not enter the area
- coordinating with the U.S. Coast Guard to issue Notices to Mariners notifying the public about durations and locations of potentially hazardous activities

Consequently, the potential for training activities using in-water energy to impact public health and safety under Alternative 1 would be unlikely.

Impacts from In-Water Energy Under Alternative 1 for Testing Activities

Under Alternative 1, the Navy would conduct active sonar testing activities such as anti-submarine warfare, mine warfare, pierside sonar testing, unmanned underwater vehicle testing, and sonar maintenance in the Gulf of Mexico, Jacksonville, Navy Cherry Point, Northeast, and Virginia Capes Range Complexes; Naval Undersea Warfare Center Division, Newport Testing Range; South Florida Ocean Measurement Facility; and Fort Pierce, Florida. The Navy would conduct pierside testing of active sonar in Bath, Maine; Groton, Connecticut; Kings Bay, Georgia; Newport, Rhode Island; Norfolk, Virginia; Pascagoula, Mississippi; Port Canaveral, Florida; and Portsmouth, New Hampshire.

The Navy would conduct testing activities involving in-water detonations, such as surface warfare, anti-submarine warfare, mine warfare, and surface combatant sea trials in specific training areas in the Virginia Capes, Navy Cherry Point, Jacksonville, and Gulf of Mexico Range Complexes.

As discussed in the subsection above, Impacts from In-Water Energy Under Alternative 1 for Training Activities, the Navy implements operating procedures designed to protect public health and safety. Under this alternative, these procedures would be implemented. Consequently, the potential for testing activities using in-water energy to impact public health and safety under Alternative 1 would be unlikely.

3.12.3.1.2 Impacts from In-Water Energy Under Alternative 2

Impacts from In-Water Energy Under Alternative 2 for Training Activities

Alternative 2 reflects an increase in sonar training over that presented in Alternative 1. Training locations would remain the same as those of Alternative 1. This alternative would also include a maximum of four Composite Training Unit Exercises each year in the Gulf of Mexico. The Navy would implement standard operating and safety procedures, as discussed previously. Therefore, potential for impacts on public health and safety beyond those identified for Alternative 1 would be unlikely.

The Navy would conduct activities involving in-water explosions, such as surface warfare, mine warfare, and civilian port defense at current locations. In this case also, the Navy would implement standard operating and safety procedures. Therefore, potential for impacts on public health and safety beyond those identified for Alternative 1 would be unlikely.

Impacts from In-Water Energy Under Alternative 2 for Testing Activities

Under Alternative 2, the Navy would conduct sonar testing activities (both at-sea and pierside) in the same areas and at the same levels identified under Alternative 1. The Navy would implement standard operating and safety procedures. Therefore, an increased potential for impacts on public health and safety beyond those identified for Alternative 1 would be unlikely.

The Navy would conduct testing activities involving in-water explosions, such as air warfare, surface warfare, anti-submarine warfare, mine warfare, surface combatant sea trials, littoral combat ship testing, ship shock trials, combat ship qualifications, at-sea explosive testing, and sonobuoy lot acceptance testing in the same areas identified under Alternative 1, although under Alternative 2, the Navy would increase the number of some testing activities involving in-water explosions. The Navy would implement standard operating and safety procedures. Therefore, an increased potential for impacts on public health and safety beyond those identified for Alternative 1 would be unlikely.

3.12.3.1.3 Impacts from In-Water Energy Under the No Action Alternative

Impacts from In-Water Energy Under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Various in-water energy stressors (e.g., acoustic and electromagnetic) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities. However, with regard to diminished military readiness, the No Action Alternative would have adverse impacts on public health and safety.

3.12.3.2 In-Air Energy

In-air energy stressors include sources of electromagnetic energy and lasers. The sources of electromagnetic energy include radar and electronic warfare systems. These systems operate similarly to other navigational aids and radars at civilian airports and television weather stations throughout the United States. Electronic warfare systems emit electromagnetic energy similar to that from cell phones, handheld radios, commercial radio stations, and television stations. The Navy follows documented safety procedures to protect Navy personnel and the public from electromagnetic energy hazards. These procedures include setting the heights and angles of electromagnetic energy transmissions to avoid direct human exposure, posting warning signs, establishing safe operating levels, and activating warning lights when radar systems are operational.

High-energy lasers are used as weapons to disable surface targets. The Navy would operate high-energy laser equipment in accordance with procedures defined in Chief of Naval Operations Instruction 5100.23G, Navy Safety and Occupational Health Program Manual (U.S. Department of the Navy, 2011a). These high-energy light sources can cause eye injuries and burns. A comprehensive safety program exists for the use of lasers. Current Navy safety procedures protect individuals from the hazard of injuries caused by laser energy. Laser safety requirements for aircraft and vessels mandate verification that target areas are clear before commencement of an exercise. In the case of aircraft, during actual laser use, the aircraft run-in headings are restricted to preclude inadvertent lasing of areas where the public may be present.

Training and testing activities involving electromagnetic energy include electronic warfare activities that use airborne and surface electronic jamming devices to defeat tracking and communications systems. Training activities involving low-energy lasers include surface warfare and mine warfare; there are no training activities that use high-energy lasers.

3.12.3.2.1 Impacts from In-Air Energy Under Alternative 1

Impacts from In-Air Energy Under Alternative 1 for Training Activities

Under Alternative 1, the Navy would conduct electronic warfare training activities involving electromagnetic energy sources in the Virginia Capes, Navy Cherry Point, Jacksonville, and Gulf of Mexico Range Complexes. The Navy would conduct laser targeting activities and mine detection activities using lasers within the Virginia Capes and Jacksonville Range Complexes.

It is unlikely that the public would be exposed to electromagnetic energy sources or lasers from training activities under Alternative 1, because the Navy would not conduct these activities in proximity to the public. Additionally, the Navy would employ strict safety procedures for the use of lasers and other electromagnetic energy sources, as discussed in Sections 3.12.2.2.5 (Electromagnetic Energy Safety) and 3.12.2.2.6 (Laser Safety). Consequently, the potential for training activities to impact public health and safety under Alternative 1 would be unlikely.

Impacts from In-Air Energy Under Alternative 1 for Testing Activities

Under Alternative 1, the Navy would conduct electronic warfare testing activities involving electromagnetic energy sources and lasers at locations identified under Alternative 1. High-energy laser weapons testing activities (the only testing activities using high-energy lasers) would occur only in the Virginia Capes Range Complex.

The Navy would not conduct these testing activities in proximity to the public. Additionally, the Navy would employ strict safety procedures for the use of lasers and other electromagnetic energy sources, as discussed in Section 3.12.2.2.5 (Electromagnetic Energy Safety) and Section 3.12.2.2.6 (Laser Safety). Consequently, the potential for testing activities to impact public health and safety would be unlikely.

3.12.3.2.2 Impacts from In-Air Energy Under Alternative 2

Impacts from In-Air Energy Under Alternative 2 for Training Activities

Alternative 2 would involve the same locations and number of training activities described under Alternative 1 for electromagnetic energy and lasers. The Navy would implement standard operating and safety procedures. Therefore, an increased potential for impacts on public health and safety beyond those identified for Alternative 1 would be unlikely.

Impacts from In-Air Energy Under Alternative 2 for Testing Activities

Alternative 2 would involve the same locations and number of testing activities described under Alternative 1 for electromagnetic energy and lasers. The Navy would implement standard operating and safety procedures. Therefore, an increased potential for impacts on public health and safety beyond those identified for Alternative 1 would be unlikely for testing activities.

3.12.3.2.3 Impacts from In-Air Energy Under the No Action Alternative

Impacts from In-Air Energy Under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. In-air energy stressors (e.g., laser and electromagnetic) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities. However, with regard to diminished military readiness, the No Action Alternative would have adverse impacts on public health and safety.

3.12.3.3 Physical Interactions

This section evaluates potential impacts associated with the interaction of Navy aircraft, vessels, and equipment with the general public. Public health and safety could be impacted by physical collisions between Navy assets and the public. As described in Section 3.0.3.3.4 (Physical Disturbance and Strike Stressors), Navy aircraft, vessels, targets, munitions, towed devices, seafloor devices, and other training and testing expended materials could be directly, physically encountered by recreational, commercial, institutional, and governmental aircraft, vessels, and individuals such as swimmers, divers, and anglers.

Like private aircraft, Navy aircraft are required to observe and avoid other aircraft. In addition, the Federal Aviation Administration issues Notices to Airmen advising private and commercial pilots about scheduled Navy training and testing activities. Finally, Navy personnel are required to verify that the range is clear of non-participants before initiating any activity that could be potentially hazardous to the public. Together, these procedures would minimize the potential for adverse interactions between Navy and non-participant aircraft. Application of standard operating procedures would minimize the potential for interaction between private or commercial aircraft with Navy training or testing activities employing aircraft, munitions, and aerial targets.

Private and commercial vessels traversing the Study Area during training or testing activities may interact with Navy vessels, munitions, and surface targets. Naval Vessel Protection Zones established by U.S. Coast Guard regulations (33 CFR section 165.2010) require other (non-Navy) vessels to slow down to a minimum speed within 500 yards of a Navy vessel greater than 100 ft. long; they are prohibited from approaching within 100 yards of a Navy vessel greater than 100 ft. long. Both Navy and public vessels operate under maritime navigational rules requiring them to observe and avoid other vessels. In addition, Notices to Mariners advise vessel operators about when and where Navy training and testing activities are scheduled. Finally, Navy personnel are required to verify that the range is clear of non-participants before initiating any potentially hazardous activity. Together, these procedures minimize the potential for adverse interactions between Navy and nonparticipant vessels.

Recreational diving within the Study Area takes place primarily at known diving sites such as shipwrecks and reefs. The locations of these popular dive sites are well-documented, dive boats are typically well-marked, and diver-down flags are visible from a distance. As a result, dive sites would be easily avoided by ships conducting training or testing activities. Interactions between training and testing activities and recreational divers, thus, would not be expected. Similar knowledge and avoidance of popular fishing areas would minimize interactions between training and testing activities and recreational fishing.

Commercial and recreational fishing activities could encounter military expended materials that could entangle fishing gear and pose a safety risk. The Navy recovers many surface targets after they are used to avoid them becoming a collision risk or entanglement risk. Unrecoverable pieces of military expended materials are typically small (such as sonobuoys), constructed of soft materials (such as target cardboard boxes or tethered target balloons), or intended to sink to the bottom after their useful function is completed, so they would not pose a collision or entanglement risk to civilian vessels or equipment. Thus, these targets do not pose a safety risk to individuals using the area for recreation because the public would not likely be exposed to these items before they sank to the seafloor.

The footprint of military expended materials in the Study Area is discussed in Habitats, Section 3.5.3.4.3 (Impacts from Military Expended Materials). Figure 3.5-15 (Alternative 1 – Annual Proportional Impact (Acres) from Military Expended Materials by Substrate Type for Training and Testing Compared to Total Habitat Within the Study Area) and Figure 3.5-16 (Alternative 2 – Annual Proportional Impact (Acres) from Military Expended Materials by Substrate Type for Training and Testing Compared to Total Vulnerable Habitat Within the Range Complexes of the Large Marine Ecosystems Within the Study Area) illustrate the very small percentage of marine substrate (much less than 1 percent of the total area of documented soft bottom, intermediate, or hard bottom in their respective training or testing areas). Given the small footprint of military expended materials estimated here, it is unlikely the public would encounter military expended materials during recreational or commercial fishing activities.

Section 3.2 (Sediments and Water Quality) discusses the low failure rate of munitions, which indicates that most munitions operate as intended. While fishing activities may encounter undetonated munitions, it would be unlikely because of the deep waters and low density of munitions within the large size of the Study Area. Depending on the circumstances (i.e., emergency or imminent threat), Navy Explosive Ordnance Disposal support or other resources could be asked to respond and safely dispose of any munitions.

Additionally, the public may encounter military expended materials, such as pieces of plastic or fabric that wash up on the seashore. Most of this material does not pose a potential for safety impacts; however, other items, such as flares may pose potential safety impacts. Flares, such as the ones dropped into the ocean by military planes to use as markers, contain chemicals designed to burn at high intensity, allowing them to be visible from long distances. The chemicals (e.g., phosphorous) in unexpended or partially-burned flares can reignite when exposed to air or water, resulting in severe burns if handled. The presence of any flares should be reported to appropriate agencies, such as the police or U.S. Coast Guard, who would then contact experienced personnel for their proper disposal.

The analysis focuses on the potential for a direct physical interaction with aircraft, vessels, targets, or other expended materials. A vessel or aircraft transiting through the water or air (as would be involved in the vast majority of proposed activities) inherently involves the risk of collision with other vessels or aircraft. But this risk is greatly diminished by a shared set of international navigational rules for vessels and aircraft. The greatest potential for a physical interaction would be along the coast and near populated areas, because that is where public activities are concentrated.

3.12.3.3.1 Impacts from Physical Interactions Under Alternative 1

Impacts from Physical Interactions Under Alternative 1 for Training Activities

Under Alternative 1, the Navy would conduct training activities at current locations. The potential for a direct physical interaction between the public and aircraft, vessels, targets, or expended materials would not change from current conditions. The Navy implements strict operating procedures that protect public health and safety. These operating procedures include ensuring clearance of the area before commencing training activities.

As discussed in Section 3.12.3.3 (Physical Interactions), there would be no impact on public health and safety from physical interactions with training activities, based on the Navy's implementation of standard operating procedures that protect public health and safety. These operating procedures include ensuring clearance of the area before commencing training activities involving physical interactions. Because of the Navy's safety procedures, the potential for training activities to impact public health and safety under Alternative 1 would be unlikely.

Impacts from Physical Interactions Under Alternative 1 for Testing Activities

Because the potential for a physical interaction is not activity or location specific, the analysis for the training activities above applies to testing activities under Alternative 1. As concluded above, because of the Navy's safety procedures, the potential for testing activities to impact public health and safety under Alternative 1 would be unlikely.

3.12.3.3.2 Impacts from Physical Interactions Under Alternative 2

Impacts from Physical Interactions Under Alternative 2 for Training Activities

Under Alternative 2, the Navy would increase the number of at-sea training activities over that presented in Alternative 1. While Alternative 2 would adjust locations and number of some training activities, the Navy would implement standard operating procedures, as discussed in Section 3.12.3.3 (Physical Interactions). Therefore, the potential for impacts on public health and safety would remain unlikely.

Impacts from Physical Interactions Under Alternative 2 for Testing Activities

Under Alternative 2, the Navy would increase some types of testing activities. Because the potential for a physical interaction is not activity-specific or location-specific, the analysis for the training activities above applies to testing activities under Alternative 2. As concluded above, because of the Navy's safety procedures, the potential for testing activities to impact public health and safety under Alternative 2 would remain unlikely.

3.12.3.3.3 Impacts from Physical Interactions Under the No Action Alternative

Impacts from Physical Interactions Under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Physical interaction stressors (e.g., collision with a vessel, interaction with a military expended material) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would remain either unchanged or would improve slightly after cessation of ongoing training and testing activities. However, with regard to diminished military readiness, the No Action Alternative would have adverse impacts on public health and safety.

3.12.3.4 Secondary (Sediments and Water Quality)

Secondary stressors are defined as those stressors that could pose indirect impacts on public health and safety through degradation in water quality or changes to sediment. These stressors include the use of explosives, explosive chemical byproducts, and other materials potentially generated (marine markers, flares, chaff, targets, and miscellaneous components of other materials).

3.12.3.4.1 Impacts from Sediments and Water Quality Under Alternative 1

Impacts from Sediments and Water Quality Under Alternative 1 for Training Activities

Section 3.2 (Sediments and Water Quality) considers the impacts on marine sediments and water quality from these stressors. The analysis in Section 3.2 (Sediments and Water Quality) determined that any impacts to water quality would be temporary and minimal. No state or federal standards or guidelines would be violated. Consequently, training under Alternative 1 would result in no indirect impacts on public health and safety associated with sediments and water quality.

Impacts from Sediments and Water Quality Under Alternative 1 for Testing Activities

The analysis in Section 3.2 (Sediments and Water Quality) determined that any impacts to water quality would be temporary and minimal. No state or federal standards or guidelines would be violated. Consequently, testing under Alternative 1 would result in no indirect impacts on public health and safety associated with sediments and water quality.

3.12.3.4.2 Impacts from Under Alternative 2

Impacts from Sediments and Water Quality Under Alternative 2 for Training Activities

The analysis in Section 3.2 (Sediments and Water Quality) determined that any impacts to water quality would be temporary and minimal. No state or federal standards or guidelines would be violated. Consequently, training under Alternative 2 would result in no indirect impacts on public health and safety associated with sediments and water quality.

Impacts from Sediments and Water Quality Under Alternative 2 for Testing Activities

The analysis in Section 3.2 (Sediments and Water Quality) determined that any impacts to water quality would be temporary and minimal. No state or federal standards or guidelines would be violated. Consequently, testing under Alternative 2 would result in no indirect impacts on public health and safety associated with sediments and water quality.

3.12.3.4.3 Impacts from Sediments and Water Quality Under the No Action Alternative

Impacts from Sediments and Water Quality Under the No Action Alternative for Training and Testing Activities

Under the No Action Alternative, the Navy would not conduct the proposed training and testing activities in the AFTT Study Area. Secondary stressors (e.g., chemicals affecting water or sediment quality) would not be introduced into the marine environment. Therefore, baseline conditions of the existing environment would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities. However, with regard to diminished military readiness, the No Action Alternative would have adverse impacts on public health and safety.

3.12.4 Summary of Potential Impacts on Public Health and Safety

3.12.4.1 Combined Impacts of All Stressors Under Alternative 1

Activities described in this EIS/OEIS that have potential to impact public health and safety include those that release in-water energy or in-air energy or those that result in physical interactions, as well as those that have indirect impacts from changes to sediments and water quality. As described throughout this section, the Navy promotes a proactive and comprehensive safety program designed to reduce to the greatest extent possible any potential impacts on public health and safety from training and testing activities. Elements of this program include implementing strict navigation rules, coordinating and disseminating information on potentially hazardous activities, and the use of remote sensing technologies (e.g., radar, sonar) and/or trained Navy Lookouts to ensure that training and testing areas are clear of non-participants. Navy safety considerations are appropriate to the location and type of activity being conducted, irrespective of the number of activities occurring concurrently; consequently, no elevated impacts from the combined effect of all stressors are expected.

3.12.4.2 Combined Impacts of All Stressors Under Alternative 2

As with Alternative 1, no elevated impacts under Alternative 2 are expected from the combined effect of all stressors. Navy safety considerations are appropriate to the location and type of activity being conducted, irrespective of the number of activities concurrently conducted.

3.12.4.3 Combined Impacts of All Stressors Under the No Action Alternative

Although Navy at-sea training and testing activities within the Study Area would cease under the No Action Alternative, with respect to combined impacts of stressors, there would be no appreciable change in potential impacts on public health and safety, as these activities (currently or as proposed) would be unlikely to affect public health and safety. However, diminished military readiness under the No Action Alternative would adversely affect public health and safety.

This page intentionally left blank.

References

Professional Association of Diving Instructors. (2011). *Scuba Certification Frequently Asked Questions*. Retrieved from http://www.padi.com/scuba/scuba-diving-guide/start-scuba-diving/scuba-certification-faq/default.aspx.

U.S. Department of Defense. (2002). *Electromagnetic Environmental Effects: Requirements for Systems*. (MIL-STD-464A). Wright-Patterson Air Force Base, OH: U.S. Air Force/Aeronautical Systems Center.

U.S. Department of Defense. (2009). *Protecting Personnel from Electromagnetic Fields*. (DoD Instruction 6055.11). Washington, DC: Under Secretary of Defense for Acquisition, Technology, and Logistics.

U.S. Department of Defense. (2012). *Department of Defense Manual 6055.09-M, DoD Ammunition and Explosives Safety Standards: General Explosives Safety Information and Requirements*. Washington, DC: Department of Defense.

U.S. Department of Defense. (2015). *Department of Defense Instruction 3222.03, DoD Electromagnetic Environmental Effects (E3) Program*. Washington, DC: Department of Defense.

U.S. Department of the Navy. (2007). *Airspace Procedures and Planning Manual* (OPNAVINST 370.2J). Washington, DC: U.S. Department of the Navy.

U.S. Department of the Navy. (2008a). *Test and Safety Planning*. (NSWC PCD Instruction 5100.30D).

U.S. Department of the Navy. (2008b). *Navy Laser Hazards Control Program OPNAVINST 5100.27B / Marine Corps Order 5104.1C*. Washington, DC: Office of the Chief of Naval Operations and Headquarters United States Marine Corps.

U.S. Department of the Navy. (2009). *Narragansett Bay Shallow Water Test Facility*. Retrieved from https://www.fbo.gov/?s=opportunity&mode=form&tab=core&id=5fbacfbaa49a922882285d9b3bf3eef7&_cview=1.

U.S. Department of the Navy. (2011a). *Navy Safety and Occupational Health Program Manual*. (OPNAVINST 5100.23G CH-1). Washington, DC: U.S. Department of the Navy.

U.S. Department of the Navy. (2011b). *U.S. Navy Dive Manual*. Washington, DC: Commander, Naval Sea Systems Command.

U.S. Department of the Navy. (2015a). *Manual for the Utilization of Fleet Area Control and Surveillance Facility, Virginia Capes Operations Areas*. (FACSFACVACAPESINST 3120.1N). Virginia Beach, VA: Department of the Navy.

U.S. Department of the Navy. (2015b). *Fleet Area Control and Surveillance Facility Jacksonville Instruction 3001.G, Operations Manual*. Jacksonville, FL: Department of the Navy.

U.S. Department of the Navy. (2016). *Commander Operational Test and Evaluation Force Instruction 3980.2G, Operational Test Directors Manual*. Norfolk, VA: Department of the Navy.

This page intentionally left blank.

Final
Environmental Impact Statement/Overseas Environmental Impact Statement
Atlantic Fleet Training and Testing

TABLE OF CONTENTS

List of Figures

This section does not contain figures.

List of Tables

4 CUMULATIVE IMPACTS

4.1 PRINCIPLES OF CUMULATIVE IMPACTS ANALYSIS

The approach taken herein to analyze cumulative effects meets the objectives of the National Environmental Policy Act (NEPA) of 1969, Council on Environmental Quality regulations, and Council on Environmental Quality guidance. Council on Environmental Quality regulations (40 Code of Federal Regulations [CFR] 1500-1508) provide the implementing procedures for NEPA. The regulations define “cumulative effects” as:

> *…the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time* (40 CFR 1508.7).

The Council on Environmental Quality provides guidance on cumulative impacts analysis in *Considering Cumulative Effects Under the NEPA* (Council on Environmental Quality, 1997). This guidance further identifies cumulative effects as those environmental effects resulting “from spatial and temporal crowding of environmental perturbations. The effects of human activities will accumulate when a second perturbation occurs at a site before the ecosystem can fully rebound from the effects of the first perturbation.” Noting that environmental impacts result from a diversity of sources and processes, this Council on Environmental Quality guidance observes that “no universally accepted framework for cumulative effects analysis exists,” while also noting that certain general principles have gained acceptance. One such principle provides that “cumulative effects analysis should be conducted within the context of resource, ecosystem, and community thresholds—levels of stress beyond which the desired condition degrades.” Thus, “each resource, ecosystem, and human community must be analyzed in terms of its ability to accommodate additional effects, based on its own time and space parameters.” Therefore, cumulative effects analysis normally will encompass a region of influence or geographic boundaries beyond the immediate area of the proposed action, and a time frame including past actions and foreseeable future actions, to capture these additional effects. Bounding the cumulative effects analysis is a complex undertaking, appropriately limited by practical considerations. Thus, Council on Environmental Quality guidelines observe that it “is not practical to analyze cumulative effects of an action on the universe; the list of environmental effects must focus on those that are truly meaningful.”

4.1.1 DETERMINATION OF SIGNIFICANCE

Per the *Council on Environmental Quality’s Considering Cumulative Effects Under the NEPA* (Council on Environmental Quality, 1997), the “levels of acceptable change used to determine the significance of effects will vary depending on the type of resource being analyzed, the condition of the resource, and the importance of the resource as an issue.” Furthermore, “this change is evaluated in terms of both the total threshold beyond which the resource degrades to unacceptable levels and the incremental contribution of the proposed action to reaching that threshold.” In practice, “the analyst must determine the realistic potential for the resource to sustain itself in the future and whether the proposed action will affect this potential.” In other words, for a proposed action to have a cumulatively significant impact on an environmental resource, two conditions must be met. First, the combined effects of all identified past, present, and reasonably foreseeable projects, activities, and processes on a resource, including the effects of the proposed action, must be significant. Second, the proposed action must make a measurable or meaningful contribution to that significant cumulative impact.

4.1.2 Identifying Region of Influence or Geographical Boundaries for Cumulative Impacts Analysis

The region of influence or geographic boundaries for analyses of cumulative impacts can vary for different resources and environmental media. Council on Environmental Quality guidance (Council on Environmental Quality, 1997) indicates that geographic boundaries for cumulative impacts almost always should be expanded beyond those for the project-specific analyses. This guidance continues, indicating that one way to evaluate geographic boundaries is to consider the distance an effect can travel, and it identifies potential cumulative assessment boundaries accordingly. For air quality, the potentially affected air quality regions are generally the appropriate boundaries for assessment of cumulative impacts from releases of pollutants into the atmosphere; however, greenhouse gases impact the entire atmosphere. For water resources and land-based effects, watershed boundaries may be the appropriate regional boundary. For wide-ranging or migratory wildlife, specifically marine mammals, fish, turtles, and sea birds, any impacts of the Proposed Action might combine with the impacts of other activities or processes within the range of the population.

A region of influence for evaluating the cumulative impacts of the Proposed Action is defined for each resource in Section 4.4 (Resource-Specific Cumulative Impacts). The basic region of influence or geographic boundary for the majority of resources analyzed for cumulative impacts in this Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) is the entire Atlantic Fleet Training and Testing (AFTT) Study Area (Figure 2.1-1), although the geographic boundaries for cumulative impacts analysis for some resources are expanded to include activities outside the Study Area that might impact migratory or wide-ranging animals. Other activities potentially originating from outside the Study Area that are considered in this analysis include impacts associated with maritime traffic (e.g., vessel strikes and underwater noise) and commercial fishing (e.g., bycatch and entanglement).

4.2 Projects and Other Activities Analyzed for Cumulative Impacts

Cumulative analysis includes consideration of past, present, and reasonably foreseeable future actions. For past actions, the cumulative impacts analysis only considers those actions or activities that have had ongoing impacts that may be additive to impacts of the Proposed Action. Likewise, present and reasonably foreseeable future actions selected for inclusion in the analysis are those that may have effects additive to the effects of the Proposed Action as experienced by specific environmental receptors.

The cumulative impacts analysis makes use of the best available data, quantifying impacts where possible and relying on qualitative description and best professional judgement where detailed measurement is unavailable. Because specific information and data on past projects and actions are typically scarce, the analysis of past effects is often qualitative (Council on Environmental Quality, 1997). Likewise, analysis for ongoing actions is often inconsistent or unavailable. All likely future development or use of the region is considered to the greatest extent possible, even when foreseeable future action is not planned in sufficient detail to permit complete analysis (Council on Environmental Quality, 1997).

The cumulative impacts analysis is not bounded by a specific future timeframe. The Proposed Action includes general types of activities addressed by this EIS/OEIS that are expected to continue indefinitely, and the associated impacts could occur indefinitely. Likewise, some reasonably foreseeable future actions and other environmental considerations addressed in the cumulative impacts analysis are expected to continue indefinitely (e.g., oil and gas production, maritime traffic, commercial fishing).

While Navy training and testing requirements change over time in response to world events, it should be recognized that available information, uncertainties, and other practical constraints limit the ability to analyze cumulative impacts for the indefinite future. Navy environmental planning and compliance for training and testing activities is an ongoing process, and the Navy anticipates preparing new or supplemental environmental planning documents covering changes in training and testing activities in the Study Area as necessary. These future environmental planning documents would include cumulative impacts analysis based on information available at that time.

Table 4.2-1 describes other actions that have had, continue to have, or would be expected to have some impact upon resources also impacted by the Proposed Action within the Study Area and surrounding areas. These activities are selected based on information obtained during the scoping process and Draft EIS/OEIS public comment period (Appendix H, Public Comment Responses), communications with other agencies, a review of other military activities, literature review, previous NEPA analyses, and other available information. Table 4.2-1 focuses on identifying past and reasonably foreseeable future actions (military mission, testing, and training; offshore energy development; ocean-dependent commercial industries; and research). Table 4.2-2 focuses on other major environmental stressors or trends that tend to be widespread and arise from routine human activities and multiple past, present, and future actions. For perspective of general project locations, please refer to Figure 3.0-1 and Figures 3.0-4 through 3.0-6, which depict the Study Area, boundaries of individual training and testing locations, and large marine ecosystems and open ocean areas within and adjacent to the Study Area. Many of the commercial stressors are also depicted in Figure 3.11-1 through Figure 3.11-11.

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X=Other		
				Past	Present	Future
Military Mission, Testing, and Training Activities						
Training Activities at Eglin Gulf Test and Training Range	Warning Areas (W-151, W-168, and W-470) and Eglin Water Test Areas WTA-1 through WTA-6 Undersea, Surface, Airspace, Valparaiso, Florida	The Eglin Gulf Test and Training Range supports a variety of air operations and ordnance training and testing activities accomplished predominately over the Gulf of Mexico (Eglin Air Force Base, 2015). Eglin Gulf Test and Training Range warning areas are adjacent to Navy-operated W-155 offshore Pensacola and W-174 west of the Florida Keys. Overall, training and testing at Eglin Gulf Test and Training Range includes detonation and live munitions that have the potential for causing harassment, injury, or mortality to marine mammals and sea turtles. The Air Force has consulted with the National Marine Fisheries Service (NMFS) regarding these effect and determined Level A takes to the bottlenose dolphin and the Atlantic spotted dolphin would be avoided and Level B takes would be reduced to the greatest extent possible through mitigation measures NMFS has issued a Letter of Authorization under the Marine Mammal Protection Act (MMPA), valid from February 2018 to February 2023, for taking of marine mammals incidental to the following activities: • 86th Fighter Weapons Squadron Maritime Weapons System Evaluation Program test missions involve the use of multiple types of live and inert munitions (bombs and missiles detonated above, at, or slightly below the water surface) • Advanced Systems Employment Project actions that involve deployment of a variety of pods, air-to-air missiles, bombs, and other munitions (all inert ordnance types) • Air Force Special Operations Command training, including air-to-surface gunnery missions involving firing live gunnery rounds at targets on the water surface in the Eglin Gulf Test and Training Range, small diameter bomb, and Griffin/Hellfire missile training involving the use of live missiles and small diameter bombs in the Test and Training Range against small towed boats, and CV-22 tiltrotor aircraft training involving the firing of 0.50 caliber/7.62 mm ammunition at flares floating on the water surface	Pre- and post-event monitoring; visual and acoustic observation for marine mammals and turtles (including indicators such as *Sargassum* rafts and large schools of fish, jellyfish, and diving birds); ceasing of activities in response to sightings.	0	0	0

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
Training Activities at Eglin Gulf Test and Training Range (continued)		• 413th Flight Test Squadron Precision Strike Program activities involving firing munitions at flare targets on the water surface of the Test and Training Range and Stand-Off Precision Guided Munitions testing involving captive-carry, store separation, and weapon employment tests • 780th Test Squadron activities involving precision strike weapon test missions (launch of munitions against targets in the Test and Training Range) and Longbow Littoral Testing (data collection on tracking and impact ability of the Longbow missile on small boats) • 96th Test Wing Inert Missions (developmental testing and evaluation for wide variety of air-delivered weapons and other systems using inert bombs) • 96 Operations Group missions, which involve the support of air-to-surface missions for several user groups within Test and Training Range (National Marine Fisheries Service, 2018b)		O	O	O
Construction of the Undersea Warfare Training Range	500 square nautical miles (NM^2) of Naval Air Station Jacksonville, Florida Operating Area (OPAREA) Undersea (120 to 900 feet [ft.] deep)	Includes the installation of undersea cables and up to 300 transducer nodes linked to Naval Air Station Jacksonville, approximately 50 NM offshore from Mayport, Florida (U.S. Department of the Navy, 2009b, 2009c). The use of the range for anti-submarine warfare training and testing activities is analyzed in this EIS/OEIS as part of the Proposed Action (Section 2.0, Description of the Proposed Action and Alternatives). Construction began in Fiscal Year 2014, and initial operational capability is anticipated in Fiscal Year 2019. Short-term sedimentation/turbidity may occur with construction activities; however, no long-term impacts on any biological receptors are anticipated from the development of the Undersea Warfare Training Range. Existing conservation measures in place at Mayport beach minimize or eliminate potential adverse impacts to the nesting activities of loggerhead and green sea turtles.	Construction not to occur during calving months to avoid disturbance to the North Atlantic right whale.	C	C	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
Homeporting of Littoral Combat Ships	Naval Station Mayport, Jacksonville, Florida	Includes the construction of facilities and establishment of functions required to support the homeporting of up to 14 Littoral Combat Ships (U.S. Department of the Navy, 2013a). The first ships began to arrive in 2016 and the action is scheduled to be completed by 2020. Aircraft systems and personnel associated with the Littoral Combat Ships were analyzed in previous documents and are already established and based at Navy installations on the East Coast. Vessel transport and training activities were analyzed in the Navy's 2009 Virginia Capes, Navy Cherry Point, and Jacksonville Range Complex EIS/OEIS (U.S. Department of the Navy, 2009a). Littoral Combat Ships transits, training, and testing activities were analyzed in the AFTT Phase II EIS/OEIS (U.S. Department of the Navy, 2013a). No long-term impacts are anticipated from construction and demolition activities.		C	O	O
Joint Logistics Over-the-Shore Training	Joint Expeditionary Base Little Creek-Fort Story, Virginia or Marine Corps Base Camp Lejeune, North Carolina	Joint Logistics Over-the-Shore Training may be conducted jointly by the Navy, Marine Corps, and Army and consists of loading/unloading of cargo and personnel onto ships without fixed port facilities. Training includes in-water and land-based activities such as ferrying cargo to land from anchored ships, construction and use of an elevated causeway system from beach to water, use of water purification and liquid (fuel) transfer systems from shore to watercraft, and establishment of onshore temporary tent encampments (U.S. Department of the Navy, 2015). Impacts from Joint Logistics Over-the-Shore Training are mitigated to the greatest extent possible and include the potential to contribute minimal in-water noise from pile driving and removal (up to 30 days annually); temporary, localized impacts on soft bottom habitat and shoreline	Dune and seabeach amaranth avoidance; soft starts (pile driving); observation for marine mammals and turtles; ceasing of activities in response to sightings.	O	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
Joint Logistics Over-the-Shore Training (continued)		environment; and temporary physiological or behavioral impacts on individual birds, sea turtles, and marine mammals. Activities may affect, but are not likely to adversely affect, the fin whale, the North Atlantic right whale, and West Indian manatee, and a MMPA Letter of Authorization was requested for the Level B take of bottlenose and Atlantic spotted dolphins (U.S. Department of the Navy, 2014). The project would not be expected to result in any Level A incidental takes. Note that the pile driving component of this EA has been added to the AFTT Proposed Action and is, therefore, analyzed in the environmental consequences analysis of this EIS/OEIS rather than this cumulative impacts analysis.				
Training Conducted by U.S. Army Vessels from Joint Base Langley-Eustis	Virginia Capes Range Complex (Warning Area 50), Hampton, Virginia	The Army conducts approximately 10 surface-to-surface gunnery training events per year in the Virginia Capes Range Complex, which generally includes firing approximately 2,400 rounds (.50 caliber) from a Landing Craft Utility vessel at floating, plastic drum targets that are recovered after use. Although this action has the potential to affect marine mammals and sea turtles, analysis of potential for strikes of military expended material on marine mammals or sea turtles in Chapters 3.7 and 3.8 indicate that this is a low risk, and it is likely that these similar Army activities would have a similarly low risk.	Requires standard 200 yard safety zone	O	O	O
Demolition/ Replacement of Pier 32/ Demolition of Pier 10	At existing piers in the Thames River, Naval Submarine Base New London, Groton, Connecticut	The Proposed Action would demolish Piers 32 and 10 and replace them with one pier that meets all current Navy nuclear-powered fast attack submarine pier standards to accommodate Virginia Class submarines (U.S. Department of the Navy, 2017a). Sediment under the piers, alongside the proposed new pier, and in the navigation channel would be dredged. The quay wall north of Pier 32 may be upgraded to support a crane weight testing area. Construction impacts on marine mammals, benthic invertebrates, shellfish, and fish would be temporary in nature and include sediment suspension,	Dredge window avoids impacts to Essential Fish Habitat for Atlantic sturgeon.			C

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
Demolition/ Replacement of Pier 32/ Demolition of Pier 10 (continued)		especially from dredging, and underwater noise from demolition and pile driving. Underwater noise effects from demolition and pile driving are expected to occur periodically for up to 35 non-consecutive months (2018 to 2022), and harbor and gray seals may be exposed to Level A and Level B thresholds for marine mammals. The Navy has requested a MMPA Letter of Authorization from NMFS for incidental take of harbor and gray seal in the vicinity of the proposed action.				
Navy Atlantic Fleet Training and Testing	Approximately 2.6 million square nautical miles over the air and seaspace in the Atlantic Ocean along the eastern coast of the United States, in the Gulf of Mexico, and in portions of the Caribbean Sea – at existing at-sea range complexes and testing ranges, in high seas areas, and at Navy pier side locations, within port transit channels, near	The Navy At-Sea Policy directs the Navy to develop a comprehensive, programmatic approach to environmental compliance for exercises and training at sea (U.S. Department of the Navy, 2000). The Navy has evaluated impacts from past activities as well as present training and testing activities based on changing operational requirements, new platforms, and new systems. The Navy uses these analyses to support incidental take authorizations under the MMPA. Prior to this EIS/OEIS, the 2013 Phase II AFTT EIS/OEIS provided the most recent comprehensive analysis of the full geographic scope of areas where Navy training and testing activities have historically occurred as well as those projected for a 5-year range(U.S. Department of the Navy, 2013b). The full breadth of activities, and their potential impacts, were similar in nature to those analyzed in this EIS/OEIS, and 49,225 hours of hull-mounted mid-frequency sonar use were estimated to occur between 2013 and 2018; although, in practice the actual hours of sonar were significantly lower (Figures 2.5-1 through 2.5-3). Likewise, the detonation of a maximum of 177,749 explosives was evaluated over a 5-year period, 85% of which were Explosive Class 1 (0.1 to 0.25 lb) (Section 2.5.4, Comparison of Proposed Sonar and Explosive Use in the Action Alternatives to the 2013 – 2018 MMPA Permit Allotment). During the 2013 AFTT Phase II EIS/OEIS effort, MMPA incidental take	Mitigation measures established for most in-water activities, including specific lookout procedures and recommended mitigation zones and protection focus. A Scientific Advisory Group of leading marine mammal scientists assisted the development of an Integrated Comprehensive Monitoring Program, which coordinated monitoring efforts across all regions where the Navy trains.	O	O	

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures*[1]	*Project Timeframe C = Construction O = Operation X = Other*		
				Past	*Present*	*Future*
Navy Atlantic Fleet Training and Testing (continued)	civilian ports, and in bays, harbors, and inland waterways (see Figure 1.2-1)	authorizations and incidental take statements under the Endangered Species Act (ESA) were issued by NMFS to the Navy for range complexes on the East Coast and in the Gulf of Mexico and the Naval Surface Warfare Center, Panama City Division testing range in the Gulf of Mexico. Negligible to no impacts have been observed to populations of marine mammals, sea turtles and other marine reptiles, birds, marine vegetation, marine invertebrates, and fish from acoustic, energy, physical disturbance and strike, entanglement, ingestion, and other secondary stressors associated with Navy training and testing activities. Monitoring occurred during training and testing events and generally through the Integrated Comprehensive Monitoring Program.				
Surveillance Towed Array Sensor System Low Frequency Active Sonar	Pacific, Atlantic (including the Study Area), and Indian Ocean, and Mediterranean Sea. Undersea, 12 NM away from any coastline, 400 ft. below surface	Although the operation of Surveillance Towed Array Sensor System Low Frequency Active Sonar systems has been analyzed for potential environmental effects in the Study Area, the activity has never been used in the Study Area. The Navy utilizes Surveillance Towed Array Sensor System Low Frequency Active Sonar systems onboard several stalwart-class auxiliary general ocean surveillance ships in the western and central North Pacific Ocean, not including polar waters, and the southwestern Indian Ocean. The Navy is currently conducting covered Surveillance Towed Array Sensor System Low Frequency Active Sonar activities pursuant to a National Defense Exemption (under the MMPA). This exemption expires in August of 2019 and the Navy is in the process of updating its relevant environmental planning and compliance documents. The Navy has been operating Surveillance Towed Array Sensor System Low Frequency Active Sonar systems since 2002 in ocean areas outside of the Study Area and plans to continue the operation of up to four systems for use in routine training, testing, and military operations (U.S. Department of the Navy, 2016). These Low Frequency Active/Compact Low Frequency Active sonar occur less than 255 hours per vessel (1,020 total) over 240 days per year. NMFS consultation has not occurred specific to the Study Area as the activity	Monitoring (visual, passive acoustic, and active acoustic) and enforcing delay/ suspension protocols. Use of "fish finder" (HF/M3 sonar) detects, locates, and tracks marine mammals and, to an extent, sea turtles, that may pass close enough to the Surveillance Towed Array Sensor System Low Frequency Active sonar's transmit array to enter the mitigation zone.			

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
Surveillance Towed Array Sensor System Low Frequency Active Sonar (continued)		does not and is not likely to occur in this location. In general, the operation of Surveillance Towed Array Sensor System Low Frequency Active Sonar has low to moderate potential to affect marine mammals, sea turtles, and fishes. Anticipated impacts on turtles include ESA harassment, including non-auditory, auditory, behavioral, masking, or physiological stress impacts when turtles are in close proximity. Impacts to marine mammals are anticipated to be Level B harassment, including auditory or behavioral impacts. These impacts do not occur in the Study Area and are not likely to affect wide-ranging individuals that traverse the Study Area.				
U.S. Coast Guard Activities	U.S. Coast Guard District 1 (Maine to New York), District 5 (New Jersey to North Carolina), District 7 (South Carolina to Florida, including the Caribbean), and District 8 (Alabama to New Mexico)	The U.S. Coast Guard performs maritime humanitarian, law enforcement, and safety services in estuarine, coastal, and offshore waters. U.S. Coast Guard training and mission activities include boat and ship exercises; fixed-wing aircraft and helicopter activities; gunnery, including munitions and other expendables such as signal flares and marine markers; and the use of high frequency and ultra-high frequency sonar detection systems. U.S. Coast Guard mission and training activities contribute vessel noise and could result in collisions with marine mammals and sea turtles. Sonar detection systems could have impacts on marine mammals, including toothed whales and pinnipeds, but only short-term, minor, adverse effects would be expected as the high frequency is not unlike common commercial fish finder systems (U.S. Coast Guard, 2013). Gunnery activities could contribute military expended material to the benthic environment; however, results of Navy modeling efforts discussed for the Proposed Action indicate a low risk that marine mammals or sea turtles would be struck by military expended material during training activities, and it is likely that similar U.S. Coast Guard activities would have a similarly low risk.	Observation for marine mammals and turtles; ceasing of activities in response to sightings.	O	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
National Aeronautics and Space Administration	Offshore Wallops Flight Facility, Virginia and Kennedy Space Center at Cape Canaveral, Florida	National Aeronautics and Space Administration has designated downrange danger zones and restricted areas that include hazard and debris areas from rocket tests, satellite launches, and other range mission activities. These activities are likely to have temporary, isolated impacts on local ecosystems, including the addition of marine debris, noise, and potential for take or harassment of individual marine mammals and sea turtles. NMFS concluded that Wallops operations are infrequent enough to not warrant the need for an Incidental Take Statement for marine mammals or sea turtles from over-ocean rocket operations (U.S. Army Corps of Engineers, 2012).		O	O	O
U.S. Outer Continental Shelf Energy Development						
Oil and Gas Leasing Programs (Section 3.11.2.1.3, Oil and Gas)	Federal Waters: Gulf of Mexico Outer Continental Shelf, approximately 200 to 350 NM seaward from state (Texas, Louisiana, Alabama, Florida) jurisdictional boundary (Figures 3.11-1 through 3.11-3)	Six million of the 160 million acres (ac) in the Gulf of Mexico Outer Continental Shelf are producing oil and natural gas (Bureau of Ocean Energy Management, 2017c). There are over 2,400 facilities and 27,000 miles (mi.) of pipeline (Bureau of Safety and Environmental Enforcement, 2017a). Oil and gas leasing activities may occur on a given lease tract for 40 to 70 years and include geophysical (sonar) surveys, drilling of exploration, development and production wells; installation and operation of platforms and pipelines and support facilities; transport of hydrocarbons using pipelines or tankers to processing locations; and decommissioning. The number of active leases and wells fluctuates regularly, but on average, the Gulf of Mexico has more than 2,400 production platforms and a weekly average of 37 drilling rigs (Bureau of Safety and Environmental Enforcement, 2017a). The majority of active platforms are located in water depths from 0 to 200 meters (m) (Bureau of Safety and Environmental Enforcement, 2017c). Specifically, as of March 1, 2017 there were 3,108 active oil and gas leases over 16,493,252 ac in the Gulf of Mexico Outer Continental Shelf Region (Western Area-Texas: 484 leases over 2,738,322 ac; Central Area- Alabama, Louisiana: 2,587 leases over 13,554,260 ac; and Eastern Area- Florida: 37 leases over 200,670 ac) (Bureau of Ocean Energy Management, 2017d).	Avoidance/ protection of sensitive benthic communities, including no activity zone within 500 feet of live bottom habitat, 1,000 feet of deepwater live corals, and 500 feet of chemosynthetic habitats. Avoidance of impacts within National Marine Sanctuaries. Site-specific mitigation measures evaluated per project at lease sale offering.	C/O	C/O	C/O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures*[1]	*Project Timeframe C = Construction O = Operation X = Other*		
				Past	*Present*	*Future*
Oil and Gas Leasing Programs (Section 3.11.2.1.3, Oil and Gas) (continued)		Through March 2014, 51,305 productive wells had been drilled in the Gulf of Mexico Planning Areas, including 7,800 in the Western Area; 43,400 in the Central Area; and 105 in the Eastern Area (Bureau of Ocean Energy Management, 2015b). (See Figures 3.11-1 and 3.11-2 for locations of Bureau of Ocean Energy Management planning areas and oil and gas exploration activities.) The Final Five-Year Program schedules an additional 10 potential lease sales in all three Gulf of Mexico Planning Areas from 2017 through 2022 (Bureau of Ocean Energy Management, 2017e). Up to 4,275 exploratory drilling wells are anticipated. Existing activities would continue in the Pacific and Atlantic Outer Continental Shelf (see Figures 3.11-1 and 3.11-2 for locations of Bureau of Ocean Energy Management planning areas and oil and gas exploration activities). Ten oil and gas lease sales were held in the Atlantic between 1976 and 1983 (Bureau of Ocean Energy Management, 2014b). Fifty-one wells were drilled on the Atlantic Outer Continental Shelf between 1975 and 1984, including one well in the Mid-Atlantic Planning Area and seven wells in the South Atlantic Planning Area. In April 2017 Executive Order Implementing an America-First Offshore Energy Strategy and May 2017 Department of the Interior Secretary Order 3350 Implementing the America-First Offshore Energy Strategy require the immediate development of a new 5-Year Outer Continental Shelf Oil and Gas Leasing Program with full consideration of areas currently withdrawn from exploration, leasing, and development (including the Atlantic Ocean and Gulf of Mexico). Additionally, the Executive and Secretarial Orders require the expedited consideration of NMFS Incidental Take Authorization requests and seismic permitting applications; review of costs, opportunity costs, and adequacy of previous consultations for National Marine Sanctuaries and Marine Monuments; reconsideration of the Bureau of Safety and Environmental Enforcement Oil and Gas and Sulfur Operations in the Outer Continental Shelf-Blowout Preventer Systems and Well Control Rule (April 2016); and ceasing all promulgation of the Offshore Air Quality Control,				

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
Oil and Gas Leasing Programs (Section 3.11.2.1.3, Oil and Gas) (continued)		Reporting, and Compliance Proposed Rule (2016). Additionally, the Executive and Secretary Orders require a review with intent to rescind or revise the National Oceanic and Atmospheric Administration (NOAA) *Technical Memorandum NMFS-OPR-55, Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing* (July 2016). The majority of oil and gas structures and the pipelines linking those structures with onshore processing and refining facilities are located off of Louisiana and do not overlap with Navy testing ranges and OPAREAs (Figures 3.11-2 and 3.11-3). Potential impacts associated with Outer Continental Shelf federal oil and gas leasing activities include those associated with noise, traffic, waste discharges, sediment disturbance, and risk of accidental spills (Bureau of Ocean Energy Management, 2016c). These impacts are generally assumed to be negligible due to the dispersed and relatively small footprint of normal operations. In the event of small to catastrophic spills, however, impacts grow increasingly detrimental to marine life.				
	State Waters: Gulf of Mexico Outer Continental Shelf, 0 to 10 mi. offshore Texas, 0 to 3 mi. offshore Louisiana, Alabama, and Florida (Figure 3.11-1 through 3.11-3)	Texas, Alabama, and Louisiana operate robust oil and gas leasing programs in state offshore waters (Bureau of Ocean Energy Management, 2016d). There are no leases in Mississippi state waters. Activities and potential impacts for these programs are similar as described above for the federal program.		C/O	C/O	C/O
Floating, Production, Storage, and	Gulf of Mexico Outer Continental	Floating oil and gas production systems occur in deepwater environments, storing crude oil in tanks in the hulls of vessels and periodically offloading the crude oil to shuttle tankers or ocean-going barges for transport to shore	No Floating, Production, Storage, and Offloading	O	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
Offloading Systems	Shelf, Western and Central Planning Areas Deepwater (greater than 650 ft.)	(Minerals Management Service, 2001). At this time two systems occur in the Walker Ridge area of the Gulf of Mexico: (1) Petrobras America, Inc., located 165 mi. from Louisiana in approximately 2,500 m of water, produces oil and gas (gas is transported to shore by pipeline) (Bureau of Ocean Energy Management & Regulation and Enforcement, 2011)and (2) Royal Dutch Shell, located 200 mi. southwest of New Orleans in 2,900 m of water (The Times-Picayune, 2015). Resources impacted by Floating, Production, Storage, and Offloading systems include air quality from platform and vessel emissions and water and sediment quality especially in the event of a spill (Minerals Management Service, 2001). Marine mammals, such as the sperm whale, sea turtles, and commercial fisheries may also be impacted due to noise from helicopters, service vessels, and shuttle tankers and vessel and shuttle tanker traffic may also increase collisions with marine mammals. It is anticipated that Floating, Production, Storage, and Offloading systems have similar, negligible anticipated environmental effects and mitigation measures as those expected for other oil development and production systems. Further site-specific, technical and environmental evaluation is required for specific Floating, Production, Storage, and Offloading proposals.	systems permitted within 100 kilometers (km) of the Breton NWA Class 1 Air Quality area; emission restrictions; security and safety controls for spill prevention and damage minimization			
Liquefied Natural Gas Terminals	Atlantic Ocean and Gulf of Mexico, coast and nearshore	Liquefied Natural Gas terminals function to regasify liquid natural gas for distribution via pipeline networks. Liquefied Natural Gas is imported and exported through both offshore and nearshore/ onshore terminals. The following Liquefied Natural Gas terminals are within the Study Area: • 12 Existing Import/Export: 6 Gulf of Mexico, 6 Atlantic (Federal Energy Regulatory Commission, 2017a) • 15 Approved Import/Export: 12 Gulf of Mexico, 3 Atlantic (Federal Energy Regulatory Commission, 2017d) • 14 Proposed Export: 13 Gulf of Mexico, 1 Atlantic (Federal Energy Regulatory Commission, 2017c)		C/O	C/O	C/O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
Liquefied Natural Gas Terminals (continued)		• 2 Proposed Import: Atlantic (Federal Energy Regulatory Commission, 2017b) Potential environmental impacts include those associated with additional ship traffic, underwater noise from construction and operation, seawater intakes and discharges, and potential releases of liquefied natural gas.				
Oil and Gas Structure Removal Operations	Gulf of Mexico Outer Continental Shelf, all water depths	Decommissioning seafloor obstructions (wellheads, caissons, casing strings, platforms, and mooring devices) includes the explosive and non-explosive severing of structures and subsequent salvage and site-clearance operations (Minerals Management Service, 2005). Decommissioning operations generally occur after lease expiration, when the well or facility is no longer deemed economically viable, or when the physical condition of the structure becomes unsafe or a navigation hindrance. Roughly 108 oil and gas structures are removed annually in the Gulf of Mexico. Of these about 66 percent are removed using explosives, which are detonated inside pilings and well conductors at a depth of 15 ft. below the seafloor. Potential environmental impacts, such as injury or death to marine mammals, fish, sea turtles, and other animals due to nearby underwater blasts and site-clearance trawling activities would be mitigated to negligible most of the time, with occasional impacts being potentially adverse but not significant (Minerals Management Service, 2007). The effects of bottom-disturbing activities, such as anchoring and toppling structures, on sensitive benthic habitat and resources may include physical damage to hard bottom features, increased turbidity, and covering or smothering of sensitive habitats with re-suspended sediments. Site-specific NEPA analyses will be conducted on individual applications specifying supplementary mitigation.	General blasting criteria and scenario-specific requirements such as avoidance of hard bottom habitats and anchor restrictions for support vessel and transport use; use of turtle exclusion devices and 30 minute limits for site-clearance trawling; and observation for marine mammals and turtles, pausing activities in response to sightings	C	C	C
Wind Energy Development (Section 3.11.2.1.2, Wind)	Atlantic Ocean Outer Continental Shelf Federal waters (approximately 200 to 350 NM	Commercial-scale offshore wind facilities are similar to onshore wind facilities, and, depending on rotor size and spacing requirements, can include from 14 (110 m rotor diameter) to 40 (150 m rotor diameter) turbines in one Outer Continental Shelf block (3 statute miles by 3 statute miles) (Bureau of Ocean Energy Management, 2013b). Average leaseholds are 8 blocks and current technology limits development to waters no deeper than 100 m. Development	Implementation of proper siting and mandatory design criteria; sonic pingers and/or turtle exclusion devices to			

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
Wind Energy Development (Section 3.11.2.1.2, Wind) (continued)	seaward from state jurisdictional boundary)	includes installing the substructure, which is typically a large steel tube (up to 20 ft. diameter) driven 80 to 100 ft. below the mudline in 15 to 100 ft. water depths, with the pole and turbine mounted on top (Minerals Management Service, 2007). Each turbine is connected by power cable to an electric service platform/substation, typically located somewhere within the turbine array, from which buried high voltage cables transmit the power to an onshore substation for integration into the onshore grid. Total heights can reach upwards of 460 feet with blade tip speeds from 140 to 180 miles per hour over a rotor-swept area between 1.1 and 3.3 acres (American Wind Wildlife Institute, 2017).	minimize entanglement and entrainment potential; adherence to U.S. Coast Guard oil spill response plans; use of environmentally friendly chemicals.			
	Atlantic Ocean State waters (0 to 3 NM from shoreline of Florida, Georgia, South Carolina, North Carolina, Virginia, Maryland, Delaware, New Jersey, Rhode Island, Maine, New York, and Massachusetts)	Five wind turbines are established and active at Block Island, Rhode Island. Thirteen commercial wind energy leases have been issued in federal waters on the Outer Continental Shelf, including those offshore Delaware, Massachusetts, Maryland, New Jersey, Rhode Island, Virginia, New York, and North Carolina (Bureau of Ocean Energy Management, 2017b). Various state offshore wind energy programs are also under development. NMFS has issued or is in the process of issuing multiple Incidental Harassment Authorizations for the take of marine mammals incidental to marine site characterization surveys associated with planning for expanded offshore wind energy development in the Outer Continental Shelf. For example, Deepwater Wind New England has requested marine mammal take authorization that would be incidental to seafloor surveys performed to support the siting of potential future offshore wind projects in areas off the coast of Rhode Island and Massachusetts (Lease Area OCS–A-0486) and along potential submarine cable routes to a landfall location in Rhode Island, Massachusetts, or New York (*Federal Register* 83(87): 19711-19736 May 4, 2018). Additional offshore windfarm projects are expected in the coming years for both research and commercial development in state and federal waters. Site characterization activities include geophysical surveys, sub-bottom				

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures[1]*	*Project Timeframe C = Construction O = Operation X = Other*		
				Past	*Present*	*Future*
Wind Energy Development (Section 3.11.2.1.2, Wind) (continued)		sampling, and biological surveys. In particular, extensive aerial and boat reconnaissance baseline surveys have been performed specific to Maryland and from Cape Cod, Massachusetts, to Cape Hatteras, North Carolina, that catalog distribution and abundance of sealife potentially impacted by wind energy development in the region (Williams et al., 2015). Site assessment activities include installation of meteorological towers and meteorological buoys, data collection, and decommissioning of the towers and buoys (Bureau of Ocean Energy Management, 2012). Most impacts occur during the construction phase, which involves the highest amount of vessel traffic, noise generation (pile driving), seafloor disturbance (transmission cabling), and air emissions; however, ongoing impacts would occur from vessel and turbine strikes; moderate operational noise; disturbance of nesting areas; alteration of key habitat; or potential fuel, oil, or dielectric fluid spills (Bergström et al., 2014). Potential population-level impacts on marine mammals, fish, birds, bats, and sea turtles are mitigated in site-specific environmental review and permitting processes. In particular, impacts on sea turtles could be minor to moderate because of the technologies' potential to impede sea turtle movement and the potential of entrainment in overtopping devices. Additionally, if related onshore facilities are located in nesting areas, operation could cause minor to moderate adverse impacts on sea turtles due to hatchling disorientation from lighting, with possible major impacts if turtle nests or aggregates of hatchlings are destroyed. Proper siting, design, and other mitigation measures would minimize potential impacts on coastal sediment transport processes, marine navigation, commercial shipping, fishing activities, seafloor habitats, marine life, areas of special concern, archaeological sites, and U.S. Department of Defense (DoD) training and exercise activities.				
Marine Hydrokinetic Power	Atlantic and Gulf Coast, especially coastal Maine	Hydrokinetic power is a type of hydropower that is derived from fast-moving marine or estuarine currents driven by waves, tides, or offshore ocean currents (U.S. Department of Energy, 2015a). Although offshore hydrokinetic	No industry-standard impact minimization			C/O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures*[1]	*Project Timeframe C = Construction O = Operation X = Other*		
				Past	*Present*	*Future*
Generation (Section 3.11.2.1.1, Water)		energy is not generated in the U.S. at this time, it is anticipated that widespread testing and deployment of these technologies is possible. There are two existing licensed hydrokinetic projects on the Atlantic coast: the Cobscook Bay Tidal Project in Maine and the Roosevelt Island Tidal Energy Project in New York City. There are two hydrokinetic preliminary permits: the Western Passage Tidal Energy project located off the coast of Maine (which includes testing 15 500kW turbine-generator hydrokinetic tidal devices), and the Cape Cod Canal and Bourne Tidal projects are located in the Cape Cod Canal in Massachusetts state waters. Commercial developers are also testing scale models of Navy wave energy technology in the wave-making facility at Naval Surface Warfare Center Carderock in Maryland (U.S. Department of Energy, 2015b). Research activities may include sea trials, small-scale prototype testing, and research that may use instruments such as acoustic Doppler profile current sensors, digital recording sonar, and underwater video and still photography taken from unmanned underwater vehicles. Potential environmental impactsof testing and deployment are anticipated to be minimal and well mitigated, but are largely unknown at this time.	measures yet developed as technologies are still being engineered.			
Other Commercial Industries						
Undersea Communi-cations Cables	Oceans worldwide	Submarine cables provide the primary means of voice, data, and Internet connectivity between the mainland United States and the rest of the world (Federal Communications Commission, 2017). The Federal Communications Commission grants licenses authorizing cable applicants to install, own, and operate submarine cables and associated landing stations in the United States. Cables are installed by specialized boats across flat ocean surfaces and dug into the seabed in shallow areas. Over 550,000 mi. of cables currently exist in the world's oceans.				

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
Undersea Communi-cations Cables (continued)		Potential impacts of installation and maintenance activities would include noise and vessel strikes from boat traffic and increased seafloor disturbance and sedimentation in localized areas where the cable is installed. Likewise, electromagnetic fields are generated by some cables that may be sensed by and affect the migration behavior of some fish, sharks, rays, and eels (Bureau of Ocean Energy Management, 2016b).		C/O	O	O
Marine Mineral Extraction (Section 3.11.2.2, Mineral Extraction)	U.S. Outer Continental Shelf and shoreline, including Florida, Louisiana, Mississippi, New Jersey, North Carolina, South Carolina, Maryland, and Virginia	Extraction of minerals involves primarily hard minerals (e.g., sand and gravel), although heavy minerals (e.g., titanium and zircon) are also potential offshore resources. Between 2009 and 2016, 21 leases were executed in six states (Florida, Louisiana, North Carolina, South Carolina, New Jersey, and Virginia (Bureau of Ocean Energy Management, 2015a). Sand and gravel are dredged from leased marine areas and applied to coastal restoration projects, including beach nourishment and coastal habitat restoration (Bureau of Ocean Energy Management, 2016a). Marine mammals, fish, and sea turtles may be impacted directly by dredge operations (including vessel strikes or dredge entrainment) or indirectly by noise, turbidity, water quality, and benthic habitat alteration produced by such (Bureau of Ocean Energy Management, 2013a). Beach nourishment activities may impact nearshore habitat, including estuaries and bird and turtle nesting areas; however, site/project-specific NEPA analysis, mitigation measures, and other stipulations are established for each project that are specifically protective of local sensitive physical, biological, and cultural resources.	Dredge timing and location constraints; lighting protocols; specialized equipment requirements; monitoring; buffer establishment surrounding cultural resources and hard bottom habitat (Bureau of Ocean Energy Management, 2017a).	C/O	C/O	C/O
Commercial Fishing (Section 3.11.2.4, Commercial Fishing)	Greater Atlantic region (Main through Cape Hatteras, North Carolina) Southeast Region (North Carolina to Texas)	There are 48 different fisheries in the Greater Atlantic region (National Marine Fisheries Service, 2016b). In the Southeast Region there are 21 separate fisheries. The National Oceanic and Atmospheric Administration provides bycatch data for 50 percent of the Greater Atlantic fisheries and 48 percent of those that occur in the Southeast. Figure 3.11-5 illustrates the decline of total fish caught in the Atlantic since 1956; Figure 3.11-6 shows a similar decline in the Gulf of Mexico. The NMFS issues fishing vessel, dealer, and commercial operator permits and fishing authorizations as required under the various Federal Fishery Regulations.	Various bycatch mitigation technologies, quotas, and seasonal restrictions required per the fishery-specific permit process.	O	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
Commercial Fishing (Section 3.11.2.4, Commercial Fishing) (continued)		Commercial fishing can adversely affect fish populations, non-target species, and habitats. Ecological extinction caused by overfishing precedes all other pervasive human disturbance of coastal ecosystems (Jackson et al., 2001). Approximately 30 percent of the U.S. managed stocks are overfished (National Marine Fisheries Service, 2009b). Bycatch includes the unintentional capture of fish, marine mammals, sea turtles, seabirds, and other non-targeted species that occur incidental to normal fishing operations. Fisheries bycatch has been identified as a primary driver of population declines in several groups of marine species, including sharks, mammals, seabirds, and sea turtles (Wallace et al., 2010). Commercial fishing often includes the use of mobile fishing gear, such as bottom trawls, which increases turbidity, alters surface sediment and bottom habitats, removes prey (leading to declines in predator abundance), removes predators, and generates marine debris. Ghost fishing occurs when lost and abandoned fishing gear, such as gill nets, purse seines, and long-lines, continue to ensnare fish and other marine animals without human oversight and removal. Lost gear fouls and disrupts bottom habitats and has the potential to entangle or be ingested by marine animals.				
Recreational Fishing (Section 3.11.2.4.2, Recreational Fishing)		In 2015, more than 5.2 million residents of Atlantic coast states participated in marine recreational fishing. All participants, including visitors, took nearly 34 million trips and caught approximately 188 million fish (National Marine Fisheries Service, 2015c). In the Gulf of Mexico in 2015, nearly 2.7 million residents of Gulf Coast states participated in marine recreational fishing, taking 21 million trips and catching almost 143 million fish. Approximately 10 percent of the recreational fishing catch is from federal waters, and most recreational fishing occurs in estuarine areas. Recreational fishing includes impacts from vessel traffic (strike, noise, water pollution, marine debris) and can compound impacts on fish stocks already experiencing exploitation. Recreational fishing and boat traffic usually occurs nearshore rather than in the deeper open ocean, and recreational traffic		O	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
Recreational Fishing (Section 3.11.2.4.2, Recreational Fishing) (continued)		typically frequents popular locations, which can concentrate damage in these areas from anchors or other bottom-disturbing equipment.				
Aquaculture (Section 3.11.2.5, Aquaculture)	State waters bordering Atlantic Ocean and Gulf of Mexico	Aquaculture is the farming of aquatic organisms such as fish, shellfish, and plants. Globally, 29 percent of stocks are fished at biologically unsustainable levels, and aquaculture helps meet demand and offsets stress to wild populations (National Marine Fisheries Service, 2015d). Aquaculture production reached an all-time high of 97 million metric tons in 2013 and is the fastest growing form of food production, at 6 percent per year globally. Species are typically farmed in U.S. state waters and include mollusks (oysters, clams, mussels) and Atlantic Salmon (National Marine Fisheries Service, 2015c). Although present throughout the Study Area, Florida and Massachusetts have the greatest number of saltwater farms in the Study Area, with 169 and 133, respectively (U.S. Department of Agriculture, 2014). The threats of aquaculture operations on wild fish populations include reduced water quality, competition for food, predation by escaped or released farmed fishes, spread of disease and parasites, and reduced genetic diversity (Kappel, 2005). These threats become apparent when farmed fish escape and enter the natural ecosystem (Hansen & Windsor, 2006; Ormerod, 2003). The Marine Aquaculture Policy provides direction to enable the development of sustainable marine aquaculture (National Marine Fisheries Service, 2015d).		C/O	C/O	C/O
Coastal Land Development and Tourism (Section 3.11.2.6, Tourism)	States bordering Atlantic Ocean and Gulf of Mexico	Coastal land development adjacent to the Study Area is both intensive and extensive, including development of homes, businesses, recreation, vacation, and ship traffic at port facilities and marinas. The Study Area coastline also includes extensive coastal tourism (hotels, resorts, restaurants, food industry, and vacation homes) and its supporting infrastructure (retail businesses, marinas, fishing tackle stores, dive shops, fishing piers, recreational boating	Site-specific mitigation often determined during Coastal Consistency Review by the respective state's	C	C	C

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures*[1]	*Project Timeframe C = Construction O = Operation X = Other*		
				Past	*Present*	*Future*
Coastal Land Development and Tourism (Section 3.11.2.6, Tourism) (continued)		harbors, beaches, and recreational fishing and whale-watching). New development in the coastal zone requires a permit from the state or local government per the Coastal Zone Management Act. (Chapter 6, Regulatory Considerations). Coastal development intensifies use of coastal resources through dune and nearshore habitat loss and disturbance, point and nonpoint source water pollution, entrainment in outflows and other structures, and air quality degradation. Self-contained underwater breathing apparatus (SCUBA) diving and snorkeling has the potential to degrade reef systems through disturbance and specimen collecting, and collisions between whale-watching ships and whales are common.	Coastal Zone Management Program			
Maritime Traffic (Section 3.11.2.3.1, Ocean Transportation)	U.S. East Coast (Figure 3.11-4)	The East Coast of the U.S. is heavily traveled by commercial, recreational, and government marine vessels with several commercial ports near Navy OPAREAs (see Figure 3.11-4 for commercially used waterways in the Study Area). The United States has grown increasingly dependent on international trade over the past 50 years. As a result, the number of active ports in the Study Area increased, ship traffic increased, and ships are larger. In 2015, there were over 23,000 port calls at Atlantic ports (including Puerto Rico and the U.S. Virgin Islands) and over 34,000 at Gulf of Mexico ports (U.S. Maritime Administration, 2015). Primary environmental concerns regarding increased maritime traffic include vessels striking marine mammals and sea turtles, introduction of non-native species through ballast water, and underwater sound from ships and other vessels. Additionally, air and water quality in busy ports can be diminished due to engine emissions and fuel leaks. Secondary impacts include development and maintenance of port infrastructure, which often include dredging requirements to maintain channel depths.		O	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures*[1]	*Project Timeframe C = Construction O = Operation X = Other*		
				Past	*Present*	*Future*
Maritime Traffic (Section 3.11.2.3.1, Ocean Transportation) (continued)	Panama Canal	A project to widen and expand the capacity of the Panama Canal was completed in June 2016 that allows larger vessels access to the East Coast ports of the U.S. (The Canal Connection, 2017). Ports of Charleston, Philadelphia, Savannah, Virginia, and Baltimore have experienced record growth in cargo volume as the larger ships traversed the Canal in 2016. Port Miami and the Port of New York and New Jersey are significantly investing in infrastructure to accommodate big ships, including deep dredging projects. (Impacts are similar to those discussed for U.S. East Coast Maritime traffic.)		C	O	O
	Atlantic coast Port Access	The Atlantic Coast Port Access Route Study is an ongoing endeavor intended to enhance navigational safety and reduce vessel collisions (U.S. Coast Guard, 2016). The Study focuses on shipping routes and near coast users between U.S. Atlantic coastal ports, approaches to coastal ports, and future uses of those ports. Establishing specific lanes and safety zones concentrates traffic, which decreases the extent of disturbance across the landscape but can increase the incidence of vessel strike, underwater noise, and air and water pollution in the concentrated traffic areas.				O
Research						
Geological and Geophysical Oil and Gas Survey Activities	Atlantic Ocean Outer Continental Shelf, Delaware Bay to south of Cape Canaveral, Florida, seaward from State jurisdictional boundary to 403 mi. offshore	Offshore geological and geophysical activities includes seismic air gun surveys and high resolution geophysical surveys supporting oil and gas, renewable energy, and marine minerals exploration (Bureau of Ocean Energy Management, 2014b). Seismic surveys are accomplished by towing a sound source such as an air gun array that emits acoustic energy in timed intervals behind a research vessel. Seismic pulses are typically emitted at intervals of 5 to 60 seconds and source levels are 230.7 decibels (dB) re 1 µPa for the large air gun array and 210.3 dB re 1 µPa for the small array (Bureau of Ocean Energy Management, 2014b). Seismic air gun surveys are loud enough to penetrate hundreds of km into the ocean floor, even after going through thousands of meters of ocean (Weilgart, 2013). Between May 2012 and April 2015, the Bureau of Ocean Energy Management received 14 applications	Establishing and monitoring (visual, passive acoustic, and active acoustic) safety and acoustic exclusion zones and enforcing delay/ suspension and spacing protocols. Seasonal management includes avoidance of North Atlantic right whale	O	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other Past	Present	Future
Geological and Geophysical Oil and Gas Survey Activities (continued)		from 6 different permittees for Atlantic Outer Continental Shelf seismic survey activities (Bureau of Safety and Environmental Enforcement, 2015). Vessel strikes and especially seismic sound production in excess of 180 dB could cause adverse impacts on marine mammals, including North Atlantic right whales, dolphins, and sea turtles (Bureau of Ocean Energy Management, 2014a). Additionally, air guns are known to kill zooplankton for at least 0.75 miles from the point of origination (Tollefson, 2017). All seismic surveys conducted by U.S. vessels are subject to required mitigation measures, the MMPA authorization process administered by the NMFS, as well as the NEPA process associated with issuing MMPA authorizations.	and sea turtle breeding season and critical habitat. Maximum sound level thresholds established and enforced.			
Academic Research		Wide-scale academic research is conducted in the region of influence by federal entities, such as the Navy and the National Oceanic and Atmospheric Administration/NMFS, as well as state and private entities and other partnerships. Academic geologists use seismic surveys/air gun arrays to study the ocean floor and beyond, including plate tectonics and volcanic activity. For example, research vessel Marcus G. Langseth is owned by the National Science Foundation and operated by the Lamont-Doherty Earth Observatory at Columbia University for use by academic researchers from universities around the world. Although academic research aims to capture data without disturbing the ambient conditions of the ocean environment, vessels contribute traffic, noise, and strike hazard; seismic activity contributes noise; and various other collection methods, such as trawling, could be disruptive to the ecosystems under observation. Impacts from academic research operations can be similar to the impacts expected from oil and gas air gun survey activities.	NMFS and states manage scientific research permits for certain activities.	O	O	O
Field Operations at	Sanctuaries located in the	NOAA conducts field operations within Marine Sanctuaries and Monuments, which include vessel operations; vessel maintenance; aircraft operations; non-	Mitigation measures are determined on a	O	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
National Marine Sanctuaries and Marine National Monuments (see Section 6.1.2, Marine Protected Areas)	Northeast/ Great Lakes, and Southeast/ Gulf of Mexico.	motorized craft operations; SCUBA or snorkel operations; onshore field work; deployment of autonomous underwater vehicles, remotely operated vehicles, gliders, or drifters; deployment of remote sensing equipment (including sonar); deployment of equipment on the seafloor; and other sampling activities (*Federal Register* 83(102): 38684-38685, August 7, 2018). The field operations primarily support resource protection, research, and education objectives of the National Marine Sanctuaries Act. The Programmatic EA of Field Operations in the Southeast and Gulf of Mexico National Marine Sanctuaries (National Oceanic and Atmospheric Administration, 2018b) and the Programmatic EA of Field Operations in the Northeast and Great Lakes National Marine Sanctuaries (National Oceanic and Atmospheric Administration, 2018a) analyze the options of maintaining the status quo and existing level of operations in National Marine Sanctuaries and Monuments for the next 5 years, or increasing the number of small boat operations and stopping the requirement for small boat best management practices in some locations. These discontinued management practices may include existing actions such as vessel speed restrictions, night operation prohibitions, on-board marine mammal and other species observer (unless specified as required or recommended mitigation measures), restriction of navigation to within marked channels, and safe distance requirements from whales.	project-by-project basis in accordance with the ESA, MMPA, Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation Management Act, and the National Historic Preservation Act.			

Table 4.2-2: Ocean Pollution and Ecosystem Alteration Trends

Stressor	***Location***	***Description***
Hypoxic Zones (Section 3.6.2.1.5, Water Quality)	Global	Hypoxia, or low oxygen, is an environmental phenomenon where the concentration of dissolved oxygen in the water column decreases to a level that can no longer support living aquatic organisms. Hypoxia occurs from the rapid growth and decay of algal blooms in response to excess nutrient loading (primarily nitrogen and phosphorus from agriculture runoff, sewage treatment plants, bilge water, and atmospheric deposition). Animals that encounter the Dead Zones flee, experience physiological stress, or suffocate (National Oceanic and Atmospheric Administration, 2016; Texas A&M University, 2011, 2014). Hypoxic zones can be natural phenomena but are occurring in increasing size and frequency due to human-induced nonpoint source water pollution (National Oceanic and Atmospheric Administration, 2016, 2017d).
	Gulf of Mexico	The northern Gulf of Mexico adjacent to the Mississippi River has the largest hypoxic zone in the U.S. and the second largest hypoxic zone worldwide. The average size of the hypoxic zone in the northern Gulf of Mexico varies year to year but from 1985 to 2014 was an average of about 5,300 square miles ($mi.^2$); in 2016 the hypoxic zone was 5,898 $mi.^2$ an area about the size of Connecticut (National Oceanic and Atmospheric Administration, 2016).
Harmful Algal Blooms (Section 3.6.2.1.5, Water Quality)	Global	Elevated nutrient loading has also been identified as a potential contributing cause of the increased incidence of harmful algal blooms, proliferations of certain marine and freshwater toxin-producing algae (National Oceanic and Atmospheric Administration, 2016, 2017d). Of the 5,000 known species of phytoplankton, there are about 100 species known to be toxic or harmful. Harmful algal blooms cause human illness and animal mortalities, including fish, bird, and marine mammals (Anderson et al., 2002; Corcoran et al., 2013; Sellner et al., 2003). Harmful algal blooms can be natural phenomena but are occurring in increasing size and frequency due to human-induced nonpoint source water pollution (National Oceanic and Atmospheric Administration, 2016, 2017d). With the projection of warming ocean waters, these harmful blooms may become more prevalent - beginning earlier, lasting longer, and covering larger geographic areas (Edwards, 2013; Moore et al., 2008).
	Gulf of Mexico	In Florida, the deaths of 107 bottlenose dolphins in 2004 and 277 manatees in 2013 were linked to harmful algal blooms (Edwards, 2013; Flewelling et al., 2005).
	Atlantic Ocean	In the Saint Lawrence Estuary, unprecedented mass mortalities of multiple species including marine fish, birds, and marine mammals were linked to a harmful algal bloom that occurred in 2008 (Starr et al., 2017).
Major Spill Events	Global	Oil and other chemical spills related to oil and gas production activities are common throughout the Gulf of Mexico and Atlantic.

Table 4.2-2: Ocean Pollution and Ecosystem Alteration Trends (continued)

Stressor	***Location***	***Description***
Major Spill Events (continued)	Gulf of Mexico	In the Gulf of Mexico from 2009 to 2016 there were a total of 5,084 spills, 50 of which were over 50 barrels (2,100 gallons) of oil (Bureau of Safety and Environmental Enforcement, 2017b). The biggest of these was in April 2010 when the Deepwater Horizon offshore drill rig, 41 mi. southeast of the Louisiana coast, exploded and sank during exploratory well drilling. This was the largest accidental marine oil spill in U.S. history releasing 4.9 million barrels (210 million gallons) of crude oil into the Gulf of Mexico (National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, 2011). Environmental impacts continue to be observed, including those arising from direct exposure of marine life to oil and oil dispersants, habitat degradation, and disturbances caused by cleanup activities. There has been extensive documentation of negative effects of the spill to deep sea corals and benthos, fish, marine mammals, sargassum, sea turtles, and other shoreline species and habitats (National Oceanic and Atmospheric Administration, 2017b).
Marine Debris (Section 3.2.2.6 Marine Debris and Water Quality)	Global	Marine debris is any anthropogenic object intentionally or unintentionally discarded, disposed of, or abandoned that enters the marine environment. An estimated 75 percent or more of marine debris consists of plastic (Hardesty & Wilcox, 2017). Approximately 80 percent of marine debris originates onshore and 20 percent from offshore sources. Marine debris is governed internationally by the 1972 London Convention and 1996 London Protocol and regulated in the U.S. through the Marine Protection, Research, and Sanctuaries Act. Marine debris has been discovered to be accumulating in gyres throughout the oceans, and two major accumulation zones exist in the Pacific Ocean and in the Atlantic east of Bermuda. Marine debris degrades marine habitat and water quality and poses ingestion and entanglement risks to marine life and birds (National Marine Fisheries Service, 2006).
Noise	Global	Ambient noise is the collection of ever-present sounds of both natural and human origin. Ambient noise in the ocean is generated by sources that are natural physical (earthquakes, rainfall, waves breaking, and lightning hitting the ocean); natural biological (snapping shrimp and the vocalizations of marine mammals), and anthropogenic (human-generated) sources. Anthropogenic sources have substantially increased ocean noise since the 1960s, and include commercial shipping, oil and gas exploration and production activities (including airgun, drilling, and explosive decommissioning), commercial and recreational fishing (including vessel noise, fish-finding sonar, fathometers, and acoustic deterrent and harassment devices), military (testing, training and mission activities), shoreline construction projects (including pile driving), recreational boating and whale-watching activities, offshore power generation (including offshore windfarms), and research (including sound from air guns, sonar, and telemetry).

Table 4.2-2: Ocean Pollution and Ecosystem Alteration Trends (continued)

Stressor	Location	Description
Climate Change (Section 3.1, Air Quality)	Global	Predictions of long-term negative environmental impacts due to climate change include sea level rise; changes in ocean surface temperature, acidity/alkalinity, and salinity; changing weather patterns with increases in the severity of storms and droughts; changes to local and regional ecosystems (including the potential loss of species); shrinking glaciers and sea ice; thawing permafrost; a longer growing season; and shifts in plant and animal ranges, fecundity, and productivity. Anthropogenic greenhouse gas emissions have changed the physical and chemical properties of the oceans, including a 1 degree Celsius temperature rise, increased carbon dioxide absorption, decreased pH, alteration of carbonate chemistry, decline in dissolved oxygen, and disruption of ocean circulation (Poloczanska et al., 2016). Observations of species responses that have been linked to anthropogenic climate change are widespread, and trends include shifts in species distribution to higher latitudes and to deeper locations, earlier onset of spring and later arrival of fall, declines in calcification, and increases in the abundance of warm-water species. Climate change is likely to negatively impact the Study Area and will contribute added stressors to all resources in the Study Area (as noted in the discussion for each resource in the Sections to follow).

4.3 Cumulative Impacts on Environmental Resources

Since the information available on past, present, and reasonably foreseeable actions varies in quality and level of detail, impacts of these actions were quantified where available data made it possible; otherwise, professional judgment and experience were used to make a qualitative assessment of impacts. Due to the large-scale of the Study Area and multiple activities and stressors interacting in the ocean environment (Table 4.2-1 and Table 4.2-2), the analysis for the incremental contribution to cumulative stress that the Proposed Action may have on a given resource is largely qualitative and speculative. Chapter 3 (Affected Environment and Environmental Consequences) includes a robust discussion of the "general threats", an analysis of aggregate project effects, and a broader level analysis specific to areas where impacts are concentrated (i.e., ranges / OPAREAS). Therefore, the Chapter 3 (Affected Environment and Environmental Consequences) analysis is referenced and briefly summarized in each section below to provide context and perspective to the rationale for the conclusions that the Proposed Action will have an insignificant contribution to the cumulative stress experienced by these resources when specific past, present, and reasonably foreseeable future actions are added to the analysis.

In this chapter, cumulative impacts were analyzed for each resource addressed in Chapter 3 (Affected Environment and Environmental Consequences) for the Proposed Action. Analysis was not separated by Alternative because the data available for the cumulative effects analysis was mostly qualitative in nature and, from a landscape-level perspective, these qualitative impacts are expected to be generally similar.

Under Alternative 1 or Alternative 2 of the Proposed Action, the Navy will implement the mitigation detailed in Chapter 5 (Mitigation) to avoid or reduce potential impacts on biological, socioeconomic, and cultural resources in the Study Area.

4.4 Resource-Specific Cumulative Impacts

In accordance with Council on Environmental Quality guidance (Council on Environmental Quality, 1997), the following cumulative impacts analysis focuses on impacts that are "truly meaningful." The level of analysis for each resource is commensurate with the intensity of the impacts identified in Chapter 3 (Affected Environment and Environmental Consequences) or the level to which impacts from the Proposed Action are expected to mingle with similar impacts from existing activities. A full analysis of potential cumulative impacts is provided for marine mammals, reptiles, and invertebrates. Rationale is also provided for an abbreviated analysis of the following resources: air quality, sediments and water quality, vegetation, habitat, fishes, birds and bats, cultural resources, socioeconomics, and public health and safety.

4.4.1 Air Quality

As described in Section 3.1.2.1.1 (Region of Influence), the region of influence for air quality is dependent on the type of pollutant, emission rates, other emission sources, and meteorology. For inert pollutants, the region of influence is generally limited to a few miles downwind from the source. For a photochemical pollutant, such as ozone, the region of influence may extend much farther downwind. The concentration of many small emission sources in a particular airshed, under the right circumstances, could incrementally contribute to regional air quality degradation.

The context for air quality analysis provided in Section 3.1 (Air Quality) includes adherence to state and federal plans enacted to achieve and maintain air quality, and these plans were developed with direct, indirect, and cumulative impacts in mind. As the plans are developed, the establishment of significance criteria includes an inventory of existing emissions and the development of thresholds that ensure new activities avoid or mitigate significant air quality impacts. A majority of the activities included in the Proposed Action are ongoing, and any emissions associated with these activities that reach land are captured in any ambient air monitoring data collected and used to quantify area air quality.

Unlike other resource areas, the analytical construct for this air quality analysis in Section 3.1 (Air Quality) is effectively a quantified look at applicable training and testing activity emissions and a region's ability to maintain or recover air quality as measured by the criteria air pollutants in light of other, existing emissions. As a whole, the air quality throughout the Study Area is generally very good as shown by ongoing monitoring of all criteria pollutants against National Ambient Air Quality Standards and State Ambient Air Quality Standards (Section 3.1.2.3, Existing Air Quality). A small proportion of nonattainment and maintenance areas are generally concentrated in the inland, urban, industrialized areas of northeastern states and a few isolated coastal areas (Table 3.1-1 through Table 3.1-4 and Figure 3.1-1 through Figure 3.1-4). The good quality of the ocean atmosphere results from the relatively low number of air pollutant sources, as well as the size, topography, and prevailing meteorological conditions throughout the Study Area.

Other activities in the Study Area that contribute to emissions of criteria air pollutants include other vessel traffic and oil and gas production activities. Oil and gas production is regulated under state and federal programs to ensure new activities avoid or mitigate significant air quality impacts (Bureau of Ocean Energy Management, 2016d). Sulfur dioxide, nitrogen dioxide, and particulate matter air emissions from non-military vessel operations operating within 200 miles of coastal areas off the U.S. and Canada and the U.S. Caribbean Sea area (around Puerto Rico and the U.S. Virgin Islands) are regulated by the International Maritime Organization. These areas are known as Emission Control Areas and were created because of the ability of these pollutant emissions to travel long distances, thus potentially impacting coastal zones and further inland.

As noted above, the majority of proposed activities are ongoing and would be captured in most states' air quality measurements. As detailed in Section 3.1 (Air Quality) sources of emissions from the proposed alternatives would include Navy vessels, aircraft, and to a lesser extent, munitions training and testing activities conducted throughout the Study Area. The Proposed Action would result in localized and temporarily elevated emissions, but criteria pollutant emissions in nonattainment or maintenance areas would not exceed *de minimis* thresholds. A few areas where ongoing training activities routinely occur are locations with greater emissions. These primarily include the lower Chesapeake Bay and surrounding tributaries where riverine training occurs. They are all attainment areas and the training in state waters is not anticipated to result in significant impacts to air quality. Hazardous air pollutant emissions are anticipated to be small and they were dismissed as a stressor of impact.

It is anticipated that the majority of emissions resulting from the Proposed Action would be released outside of state waters and would quickly disperse in the ocean environment. These emissions would largely disperse rather than concentrate due to meteorological and air chemistry processes, and these emissions could mix with emissions from other vessel traffic and oil and gas production activities. Additionally, activities occurring in state waters would likely impact onshore areas to a greater extent than more distant activities. The incremental additive impacts from combined emissions occurring beyond state water boundaries would be minor, localized, intermittent, and unlikely to contribute to future degradation of the ocean atmosphere in a way that would harm ocean ecosystems or nearshore communities. Thus, based on the analysis presented in Section 3.1 (Air Quality) and given the meteorology of the Study Area, the frequency and isolation of proposed training and testing activities (Tables 2.6-1 through 2.6-4), and the quantities of expected emissions, it is anticipated that the incremental contribution of the Proposed Action beyond state waters, when added to the impacts of all other past, present and reasonably foreseeable future actions will not result in measurable additional impacts on air quality in the Study Area or beyond.

Activities occurring within state waters can be considered as localized with greater frequency and higher probability of combining with past, present and reasonably foreseeable future actions in and adjacent to the areas where the training or testing activity is occurring. With the exception of areas around Jacksonville, Florida where training would occur on the St. Johns River and Naval Station Mayport, these areas are all in attainment. The Jacksonville (Florida)-Brunswick (Georgia) Interstate Air Quality Control Region currently contains a small area designated as nonattainment for sulfur dioxide. An analysis of the emissions from the Proposed Action activities occurring in the Jacksonville, Florida area demonstrated that emissions are well below General Conformity thresholds (Section 3.1 Air Quality). It is anticipated that the incremental contribution of the Proposed Action in the state waters in the Jacksonville, Florida area, when added to the impacts of all other past, present and reasonably foreseeable future actions, would not result in measurable additional impacts on air quality in the Jacksonville (Florida)-Brunswick (Georgia) Interstate Air Quality Control Region.

The area of greatest emissions in state waters is near the Virginia Capes Operational Area, specifically in the lower Chesapeake Bay, the York River, the James River, and their attendant tributaries. Training activities using small riverine boats and other vessels in this area were not analyzed in prior NEPA documents and account for approximately 2,600 tons per year of nitrogen oxide emissions. This represents about 21% of nitrogen oxide emissions for non-road and miscellaneous area sources in the Hampton Roads Intrastate Air Quality Control Region, which covers Isle of Wight, James City, Nansemond, Southampton, and York counties and the cities of Chesapeake, Franklin, Hampton, Newport News, Norfolk, Portsmouth, Suffolk, Virginia Beach, and Williamsburg (U.S. Environmental Protection Agency, 2016). While the riverine training activities account for a substantial percentage of non-road emissions in the region, the area is in attainment for all criteria pollutants and the level of activity has not changed appreciably over time. It is anticipated that these emissions, when added to the impacts of all other past, present and reasonably foreseeable future actions, would not result in measurable additional impacts on air quality in the Study Area or beyond.

A comparative analysis of greenhouse gas emissions and climate change is provided in Section 3.1, Air Quality.

4.4.2 Sediments and Water Quality

The region of influence for sediments and water quality includes estuaries, nearshore areas, and the open ocean. Although most impacts from anthropogenic sources tend to be geographically isolated in proximity to the source, more widespread impacts can extend into the offshore ocean environment due to transport through currents, storms, and persistent winds as well as vertical mixing in the water column. The environmental fate of materials deposited in the marine environment and the formation of degradation or corrosion products depends on geochemical conditions that may influence precipitation by chemical reaction, adsorption, and biodegradation. Transport mechanisms, such as advection by currents, dispersion, and dissolution can cause wide distribution of chemicals and small, buoyant particle debris. While this dynamic movement generally causes chemical contaminants to degrade or dilute, it can also concentrate materials in areas of the seafloor or water column where predictable currents, eddies, or gyres result in convergence zones (such as the "garbage patch" in the North Pacific Ocean or east of Bermuda where debris, particularly plastics, has accumulated and persists in the marine environment).

In order to protect sediment and water quality, several U.S. and international laws govern the discharge of fouling materials into the marine environment. Both nearshore discharge as well as discharges from open ocean activities and vessels in federal waters are regulated by the U.S. Environmental Protection Agency and state environmental programs through the Clean Water Act National Pollutant Discharge Elimination System. The deliberate disposal of waste or other matter into the ocean is governed internationally by the 1972 London Convention and 1996 London Protocol, implemented in the U.S. through the Marine Protection, Research, and Sanctuaries Act. The International Convention for the Prevention of Pollution from Ships is incorporated into U.S. law and addresses pollution generated by normal vessel operations (see Section 3.2.1.2.2, Federal Standards and Guidelines). Section 3.2.1.2 (Methods) lists applicable water quality and sediment standards, regulations, and guidelines.

Sections 3.2.2.1 (Sediments) and 3.2.2.2 (Water Quality) further describe sediment and water quality trends and impacts. Sediment quality of the Study Area is generally rated as very good with most instances of lower quality in nearshore waters adjacent to population centers or areas with concentrated past or present industrial activities (Table 3.2-1; Figures 3.2-2 through 3.2-4). Water quality in the open ocean portion of the Study Area tends to be rated as good, but in the nearshore areas water quality is generally fair or compromised due to increased use and development in coastal waters (see Figures 3.2-6 through 3.2-8). Turbidity, dissolved oxygen, solids, and chemical components from land-based urban, agricultural, and industrial point and nonpoint sources in the coastal watershed are typical stressors to sediment and water quality. Persistent organic pollutants such as polycyclic aromatic hydrocarbons, polychlorinated biphenyls, and pesticides; nutrients; bacteria; and some metals are typical components of discharge. The major pollutant encountered in the open ocean is oil from accidental spills (including chemical dispersants used in response to spills) as well as natural seeps.

All past, present, and reasonably foreseeable activities listed in Table 4.2-1 and the stressors listed in Table 4.2-2 affect marine sediments and water quality. In particular, activities contributing to climate change, continued runoff and discharge from nearshore land uses and coastal land development, maritime traffic, leakages and spills from oil and gas development, commercial fishing, mineral extraction, offshore energy development and removal operations, and marine trash impact water and sediment quality. Commercial, recreational, and institutional vessels discharge water pollutants into the AFTT Study Area as part of normal operations. Shipboard waste-handling procedures governing the discharge of nonhazardous waste streams have been established for commercial and Navy vessels. These categories of wastes include solids (garbage) and liquids, including "black water" (sewage); "grey water" (water from deck drains, showers, dishwashers, laundries, etc.); and oily wastes (oil-water mixtures). Global climate change is linked with increasing ocean acidity (pH), increasing sea surface temperatures, and increasing frequency and intensity of storms. These factors influence marine chemistry and the transport and persistence of chemical contaminants within sediment and the water column. Chemicals that remain in particulate form below a certain temperature may dissolve into the water column at a higher rate as water temperatures rise, and they may become more widely dispersed due to storms or changing currents. Particularly in nearshore areas and bays, the concentration of Navy stressors in designated ranges and ports may combine with non-Navy stressors, which may also be concentrated in these areas, to exacerbate already impacted sediments and water quality.

The analysis in Section 3.2 (Sediments and Water Quality) indicates that certain training and testing activities could result in localized, short- and long-term impacts on sediment and water quality. Activities that use explosive munitions would introduce explosion byproducts, metals, and other constituent chemicals directly into the water column when the munition detonates or into marine sediments if an explosive munition fails to detonate. Explosion byproducts are expected to disperse rapidly near the water's surface after detonation. Explosive materials and metal corrosion products would be released into adjacent sediments (within a few feet) over the long term (years to decades). However, analysis of decades-old munitions dump sites in multiple locations indicates that chemical contaminant concentrations in impacted sediment would not be expected to differ substantially from the chemical composition of control sediments located within the general area of impact (See Section 3.2.3, Environmental Consequences). Other military expended materials, such as marine markers and flares, chaff, unrecovered towed and stationary targets, sonobuoys, fiber optic cables, and miscellaneous plastic and rubber components of other expended objects are expected to sink to the seafloor and become buried in sediments. Depending on the environmental conditions, including the availability of oxygen in sediments and water temperature at the seafloor and the type of material (e.g., metal or plastic), expended material may degrade relatively quickly or persist in the environment indefinitely. Plastic and other persistent materials could incrementally contribute to marine "garbage patches" or other areas with accumulated debris.

Short-term impacts from activities using vessels may include increased turbidity and suspension of sediments in the water column (dependent on water depth). Most explosion constituents are fully consumed in detonation, and chemical, physical, or biological changes to sediments or water quality would be below applicable standards, regulations, and guidelines and would be within existing conditions or designated uses. Military expended materials associated with the Proposed Action do not generally include the same chemical constituents typically affecting coastal water quality (such as pesticides). With the exception of the few training and testing activities that occur in bays and harbors, it is unlikely that short-term increases in turbidity from training and testing activities would overlap in time and space with other past, present, or future actions. For example, training and testing with explosives would not occur near an oil rig structure removal operation that could use explosives or at the same time or place as other bottom-disturbing activities such as trawling or laying electrical transmission or communications cables.

It is possible that Navy stressors would combine with non-Navy stressors, particularly in nearshore areas and bays, such as Narragansett Bay or the Lower Chesapeake Bay, to exacerbate already impacted sediments and water quality. Although impacts may temporarily intermingle with other inputs in areas with degraded existing conditions, most of the Navy impacts to water quality and turbidity are expected to be negligible, isolated, and short term, with disturbed sediments and particulate matter quickly dispersing within the water column or settling to the seafloor and turbidity conditions returning to background levels. The Proposed Action could incrementally contribute persistent metal and plastic materials primarily to offshore ocean ecosystems. However, these relatively minute concentrations of Navy stressors are not likely to meaningfully contribute to sediment or water quality degradation, and it is anticipated that the incremental contribution of the Proposed Action when added to the impacts of all other past, present and reasonably foreseeable future actions would not result in measurable additional impacts on sediment or water quality in the Study Area or beyond.

4.4.3 Vegetation

The region of influence for vegetation includes the sunlit portions of the open ocean, coastal, and inshore waters, including the surface, water column and benthic habitat to a maximum depth of roughly 200 m. Vegetation of the Study Area includes algae (phytoplankton and seaweeds), and vascular plants that include seagrasses, emergent marsh vegetation such as cordgrass, and mangroves. Commercial activities are conducted under permits and regulations that require companies to avoid and minimize impacts on sensitive vegetation, and some harvested seaweeds are managed under Fishery Management Plans.

Seagrasses are susceptible to damage from storms and human activities but can regrow quickly if the root structure is intact and the substrate is not eroded away. Stressors include decreased light penetration and impacts on photosynthesis, particularly from sustained turbidity and nutrient loading, which can cause algal blooms. They are also susceptible to changes in environmental factors such as salinity, pH, and water temperature and physical damage. Section 3.3.2.1.2 (General Threats) includes an extensive discussion of the existing stressors to marine vegetation, including diminished water quality from excessive nutrient input, siltation, pollution (from oil, oil spills, and cleanup chemicals; sewage; and trash), climate change, fishing practices (trawling and raking), anchoring, shading from structures, propeller/vessel traffic, construction and dredging, and introduced or invasive species. Many of these stressors are components of other activities in the Study Area described in Table 4.2-1. The coverage of seagrass in the Study Area has decreased over time; from 1879 to 2006 global seagrass coverage decreased by 75 percent (Waycott et al., 2009). By comparison, algae includes a much greater diversity of species, forms, life histories, and environmental tolerances, and are thus resilient to stressors and able to rapidly recolonize disturbed environments (Levinton, 2009).

Mitigation measures within the Navy's seafloor resource mitigation areas would help avoid impacts of the Proposed Action on vegetation species that are associated with shallow-water coral reefs and live hard bottom habitats, and pre-activity observations monitor for the occurrence and avoidance of *Sargassum* mats and detached floating kelp. However, even with these mitigation measures, vegetation may be impacted directly by explosions, interactions with vessels, in-water and seafloor devices, and military expended materials. The analysis presented in Section 3.3 (Vegetation) indicates that impacts on marine vegetation are limited to destroying or damaging individual plants, and no persistent or large-scale effects on the growth, survival, distribution, or structure of vegetation are anticipated due to relatively fast growth, resilience, and abundance of the most affected species in anticipated activity areas. Likewise, the short-term, localized nature of most activities further diminishes the potential effects on marine vegetation.

The effects of other past, present, and reasonably foreseeable actions on vegetation occur primarily in the coastal and inshore waters and are associated with coastal development, maritime commerce, and the discharge of sediment and other pollutants. The Proposed Action is not expected to substantially contribute to losses of vegetation that would interfere with recovery in these regions. The incremental contribution of the Proposed Action would be insignificant as most of the proposed activities would occur in the open ocean and other areas where seagrasses and other attached marine vegetation do not grow; impacts would be localized; recovery would occur quickly; and none of the alternatives would compound impacts that have been historically significant to marine vegetation (loss of habitat due to development; nutrient loading; shading; turbidity; or changes in salinity, pH, or water temperature). Although vegetation is impacted by stressors throughout the Study Area, the Proposed Action is not likely to incrementally contribute to population- or ecosystem-level changes in the resource, and it is anticipated that the incremental contribution of the Proposed Action when added to the impacts of all other past, present and reasonably foreseeable future actions would not result in measurable additional impacts on vegetation in the Study Area or beyond.

4.4.4 INVERTEBRATES

4.4.4.1 Region of Influence

The region of influence for invertebrates includes the entire Study Area as invertebrates occur in all habitats and depths, including both the water column and benthic habitat. Invertebrates include microscopic zooplankton that drift with currents (e.g., invertebrate larvae, copepods, protozoans), larger invertebrates living in the water column (e.g., jellyfish, shrimp, squid), and benthic invertebrates that live on or in the seafloor (e.g., clams, corals, crabs, worms). Shallow-water corals typically occur in water depths less than 30 m. Deep-water corals occur at depths below 50 m (164 ft) (potentially extending to about 3,000 m [9,843 ft]) where there is no or low sunlight penetration. Deep-water corals typically do not form biogenic reefs, but rather form mounds of intermediate substrate over hard bottom areas. Corals may also occur in a transition zone of reduced light levels, called the mesophotic zone, between the water depths typically associated with shallow-water and deep-water species.

4.4.4.2 Resource Trends

As discussed in Section 3.4.2.1 (General Background) marine invertebrates are ecologically and economically crucial, performing essential ecosystem services such as coastal protection, nutrient recycling, food for other animals, and habitat formation, as well as providing income from tourism and commercial fisheries. The health and abundance of marine invertebrates are vital to the marine ecosystem and the sustainability of the world's fisheries. Invertebrates are fished for food (e.g., shrimps, lobsters, and crabs, scallops, clams, and oysters, sea urchins, sea cucumbers, squids, and octopuses); harvested for jewelry, curios, and the aquarium trade; and some are known to secrete medicinal compounds of interest to the health industry.

Seven shallow-water coral species found in the Study Area are listed as threatened under the ESA, and one deep-water coral species is designated as a Species of Concern under the ESA (Table 3.4-1). All Endangered and Special Status corals in the Study Area are located in the Gulf of Mexico, the Southeastern U.S. Continental Shelf, and the Caribbean Sea and in bays, harbors, and inshore waterways within Florida and Biscayne Bay. NOAA Fisheries maintains a species website that provides additional information on the biology, life history, species distribution (including maps), and conservation of invertebrates in the Study Area (accessible at: https://www.fisheries.noaa.gov/invertebrates).

4.4.4.3 Impacts of Other Actions

Section 3.4.2.1.4 (General Threats) includes an extensive discussion of the existing stressors to marine invertebrates, including overexploitation and destructive fishing practices, habitat degradation resulting from pollution and coastal development, disease, invasive species, oil spills, oil and gas seismic air gun exploration, global climate change and ocean acidification, human-generated noise, and bioprospecting for pharmaceutical products. Stressors specific to reef-building corals, which are generally located in more shallow zones with adequate sunlight penetration and a mean annual water temperature greater than about 64 degrees Fahrenheit, include thermal stress, disease, tropical storms, coastal development and pollution, erosion and sedimentation, tourism/recreation, fishing, trade in coral and live reef species, vessel anchoring or groundings, marine debris, predation, invasive species, military and other security-related activities, and hydrocarbon exploration. Primary threats to deep-water or cold-water corals include bottom fishing, marine debris, hydrocarbon exploration, petroleum contamination, cable and pipeline placement, waste disposal (such as lost fishing equipment or dredged sediments), and other various bottom-disturbing activities. Deep corals are susceptible to physical disturbance due to the branching and fragile growth form of some species, slow growth rate (colonies can be hundreds of years old), and low reproduction and recruitment rates. All activities described in Table 4.2-1 and stressors described in Table 4.2-2 have the potential to impact marine invertebrates due to their ubiquitous presence and relative vulnerability.

Climate Change. Specific effects of climate change on invertebrates are detailed in Section 3.4.2.1.4.2 (Climate Change). The effects of climate change include increased water temperature, ocean acidification, increased frequency or intensity of cyclonic storm events, and sea level rise, which can cause direct damage to these crucial and sensitive species well as increase their susceptibility to and resilience from encounters with all other threats, including disease, pathogens, and genetic disorders.

The primary threat to corals is the occurrence of global climate change, which has and is projected to continue to seriously impact coral reefs in the near and known future. Some coral invertebrate species may be more tolerant of changing temperatures and acidity levels than other species, but changing physical factors in ocean environments will result in altered invertebrate ecosystems. Increases in ocean temperature can lead to coral stress, bleaching, and mortality. Coral bleaching, which occurs when corals expel the symbiotic algae living in their tissues, is a stress response often tied to atypically high sea temperatures or changes in light availability but also can be attributed to nutrients, toxicants, and pathogens (National Oceanic and Atmospheric Administration, 2017c). Bleaching events have increased in frequency in recent decades and coral bleaching on a global scale has occurred during the summers of 2014, 2015, and 2016. A widespread bleaching event occurred throughout the Caribbean Sea, extending to Florida and the Gulf of Mexico, in 2005 and in portions of the Caribbean Sea and off the coast of Florida in 2015. A mass die-off of corals and other invertebrates (e.g., sponges, urchins, brittle stars, and clams) of unknown origin was documented in the Flower Garden Banks National Marine Sanctuary in the Gulf of Mexico in 2016, and a large disease outbreak was documented in numerous coral species off southeastern Florida in 2014. The results of one modeling study suggest that severe coral bleaching could occur annually at reefs off southern Florida and in the Caribbean Sea beginning between 2040 and 2050, depending on the specific location (van Hooidonk et al., 2014).

As further discussed in Section 3.4.2.1.4.2 (Climate Change), in addition to elevated sea temperatures, atypically low sea temperatures may also cause mortality to corals and most other reef organisms, suggesting that widening climate extremes could proliferate bleaching events. Likewise, ocean acidification has the potential to reduce calcification and growth rates in species with calcium carbonate skeletons, including shellfish, corals, and sponges, certain kinds of algae, and possibly even lobsters and sea cucumbers. In addition to physical effects, increased acidity may result in behavioral changes in some species, such as burrowing behavior and juvenile dispersal patterns of the soft-shell clam and reduction in the loudness and number of snaps in snapping shrimp.

Additionally, although the potential effects that climate change could have on future storm activity are uncertain, numerous researchers suggest that rising temperatures could result in little change to the overall number of storms, but that storm intensity could increase. Increased storm intensity could result in increased physical damage to individual corals and reefs constructed by the corals (which support numerous other invertebrate taxa), overturning of coral colonies, and a decrease in structural complexity (due to disproportionate breakage of branching species). However, large storms such as hurricanes may also have positive impacts on corals, such as lowering the water temperature and removing less resilient macroalgae from reef structures, which can overgrow corals.

Sea level rise could affect invertebrates by modifying or eliminating habitat, particularly estuarine and intertidal habitats bordering steep and artificially hardened shorelines. Likewise, changes in ocean circulation patterns could affect the planktonic food supply of filter- and suspension-feeding invertebrates. Cumulative effects of threats from fishing, pollution, and other human disturbance may reduce the tolerance of corals and other invertebrates to global climate change.

4.4.4.4 Impacts of the Proposed Action That May Contribute to Cumulative Impacts

The analysis presented in Section 3.4 (Invertebrates) indicates that the proposed alternatives could impact marine invertebrates through acoustic stressors (sonar and other transducers, air guns, pile driving, vessel noise, weapons noise), explosives (explosions in water), energy stressors (in-water electromagnetic devices, high energy lasers), physical disturbance or strikes (vessels and in-water devices, military expended materials, seafloor devices, pile driving), entanglement (wires and cables, decelerators/parachutes, biodegradable polymers), and ingestion of military expended materials. Potential impacts include short-term behavioral and physiological responses (Celi et al., 2015; Edmonds et al., 2016; Roberts et al., 2016). Some stressors could also result in injury or mortality to a relatively small number of individuals. The potential for impacts on ESA-listed corals (Table 3.4-1) would be avoided by mitigation designed to avoid seafloor resource mitigation areas where shallow-water corals are located. For example, the Navy will not conduct certain activities within a specified distance of shallow-water coral reefs, live hard bottom, artificial reefs, and shipwrecks (Chapter 5, Mitigation). These measures will help avoid potential impacts on invertebrates that inhabit these areas, including several areas inhabited by ESA-listed species. In addition, procedural mitigations include the requirement to avoid jellyfish aggregations during sinking exercises, ship shock trials, and the use of explosive torpedoes.

4.4.4.5 Cumulative Impacts on Invertebrates

Some direct impacts on invertebrates are expected, and the impacts of the Proposed Action could be cumulative with other actions that cause disturbance and mortality of marine invertebrates. However, it is anticipated that the incremental contribution of the proposed alternatives would be insignificant for the following reasons:

- Invertebrates are generally abundant and relatively short-lived, thus, with the exception of sessile species located near areas of repeated Navy activities (e.g., pierside locations, established channels near large naval port facilities), few individuals would likely be affected repeatedly by the same event.
- With the exception of some species such as deep-water corals, invertebrates generally have high reproductive rates, short reproductive cycles, and resilient dispersal mechanisms; thus, local communities are likely to reestablish quickly.
- Most of the proposed activities would impact small, dispersed, deep-water areas where marine invertebrates are more sparsely distributed. Navy activities may occur in the same general area (ranges), but do not occur at the same specific point each time and would therefore be unlikely to affect the same individual invertebrates.
- Marine invertebrates are not particularly susceptible to energy, entanglement, or ingestion stressors resulting from Navy activities, and none of the alternatives would result in or interact

with impacts that have been historically significant to marine invertebrates, such as overfishing, nutrient loading, disease, or the presence of invasive species.

- None of the alternatives would result in long-term or widespread changes in environmental conditions such as turbidity, salinity, pH, or water temperature that could impact marine habitats.
- The Navy will not conduct certain activities within a specified distance of shallow-water coral reefs, live hard bottom, artificial reefs, or shipwrecks. All these features that have been identified are included in Chapter 5.0 (Mitigation).

Although marine invertebrates are impacted by other stressors in the ocean environment, particularly the effects of global climate change on corals, the Proposed Action is not likely to incrementally contribute to population-level stress and decline of the resource. Due to the effects of global climate change, corals may be less resilient to additional stressors; however, it is not anticipated that the Navy will cause direct effects to surveyed reef systems. As impacts would be isolated, localized, and not likely to overlap with other relevant stressors, it is anticipated that the incremental contribution of the Proposed Action when added to the impacts of all other past, present and reasonably foreseeable future actions would not result in measurable additional impacts on invertebrates in the Study Area or beyond.

4.4.5 HABITATS

Habitats refers to the marine and estuarine nonliving (abiotic) substrates found throughout the Study Area, which are often colonized by biotic (vegetation and invertebrate) communities. Habitats vary according to geographic location, underlying geology, hydrodynamics, atmospheric conditions, and suspended particulate matter. There are basically three types of abiotic substrates based on the grain size of unconsolidated material, referred to as soft, intermediate, and hard. The soft habitats are generally comprised of fine grains that are more fluid and dynamic, whereas hard substrate does not repair and thus is susceptible to long-term scarring and damage. Artificial structures, such as shipwrecks and oil and gas platforms, underwater cables, and outflows also provide habitat for many marine organisms. Additionally, as detailed in Chapter 6, Other Regulatory Considerations, there are 13,000 square km of designated National Marine Sanctuaries in the total AFTT Study Area (0.12% of total study Area), and 2,600 square km or 0.22% of Study Area within Range Complexes, Testing Ranges, or OPAREAs.

Section 3.5.2.1.4 (General Threats) includes an extensive discussion of the existing stressors to abiotic marine habitats, including urbanization (modification of shorelines and estuaries, dredging and maintenance of ports and harbors, and creation of artificial structure habitats such as breakwaters, jetties, rock groins, seawalls, oil and gas platforms, docks, piers, wharves, underwater cables and pipelines, and artificial reefs); accumulation of marine debris; and commercial activities (oil/gas development, telecommunications infrastructure, steam and nuclear power plants, desalinization plants, alternative energy development, shipping and cruise vessels, commercial fishing, aquaculture, and tourism operations). The impact of commercial fishing trawling practices has a significant impact on bottom habitats. Most activities in Table 4.2-1 are conducted under permits and regulations that require the avoidance and minimization of impacts on marine habitats, especially shoreline and sensitive hard bottom and biogenic habitats (e.g., coral reefs and shellfish beds).

The analysis presented in Section 3.5 (Habitats) indicates that marine habitats could be affected by underwater detonations, interactions with vessels (including wave erosion and sediment suspension), military expended materials, or seafloor devices. Potential impacts include localized disturbance of the seafloor, cratering of soft bottom sediments, and structural damage to hard bottom habitats. Although some direct impacts on abiotic habitats are expected, it is anticipated that the incremental contribution of the proposed alternatives would be cumulatively insignificant for the following reasons:

- Most detonations would occur at or near the water surface and would not affect bottom habitats.
- Impacts to soft bottom habitat from bottom-laid explosives would be confined to a limited area, and it is anticipated that soft bottom habitats would recover (fill in) quickly.
- Proposed Action activities are not likely to occur at the same time/place as other activities in the Study Area, including commercial fishing operations, which have a large effect on bottom habitats. Thus, it is likely that soft bottom habitats would have the opportunity to recover from the Proposed Action before impacts from fishing or other operations could interact or compound additional stress to the ecosystems.
- Per analysis detailed in Section 3.5.3.2.2 (Impacts from Explosives) and Appendix F (Military Expended Materials and Direct Strike Calculations), the area of hard bottom potentially impacted represents a negligible percentage (less than 0.01 percent) of the total hard bottom habitat in the Study Area (Figures 3.5-1 through 3.5-4). The Navy will implement mitigation to avoid impacts from explosives, physical disturbance, and strike stressors on seafloor resources, including shallow-water coral reefs, live hard bottom, and artificial reefs, and shipwrecks, as described in Chapter 5 (Mitigation) and National Marine Sanctuaries, as described in Chapter 6 (Other Regulatory Considerations). Training and testing units are reminded of the presence of potentially sensitive areas through the Protective Measures Assessment Protocol program, which limits certain activities in these areas within the AFTT Study Area.

Although it is anticipated that damage to abiotic soft bottom habitat resulting from the Proposed Action would be limited and would recover, many other activities in the ocean are also impacting ocean bottom habitat. However, it is not likely that past, present, and future impacts would overlap Proposed Action activities in place or time before the craters or other impressions in soft bottom substrate fill in. Based on the analysis presented in Section 3.5 (Habitats) and the reasons summarized above, it is anticipated that the incremental contribution of the Proposed Action, when added to the impacts of all other past, present and reasonably foreseeable future actions, would not result in measurable additional impacts on habitats, including National Marine Sanctuaries, in the Study Area or beyond.

4.4.6 Fishes

The general region of influence for fishes extends beyond the Study Area boundaries for some species because the Study Area represents only a portion of the available habitat during its lifecycle. Fishes are usually not distributed uniformly throughout the Study Area, but are typically associated with a specific habitat type (e.g., soft bottom, reef, or open water) or can utilize a variety of habitats at different life stages. The distribution and specific habitats in which an individual of a single fish species occurs may also be influenced by its size, sex, reproductive condition, and other factors such as water temperature and depth. The highest number and diversity of fishes typically occur where the habitat is most diverse; thus, coastal ecosystems tend to support a greater diversity of species than oceanic and deep sea habitats (Moyle & Cech, 2004).

Fishes are the most numerous and diverse of the major vertebrate groups (Moyle & Cech, 2004). It is estimated that there are currently over 34,000 species of fish worldwide (Eschmeyer & Fong, 2017), with greater than half that number of species inhabiting the oceans. As discussed in Section 3.6.1 (Introduction), approximately 78 percent of all marine fish species occur in waters less than 200 m deep and in close association with land, while 13 percent are associated with the open ocean (Moyle & Cech, 2004). Table 3.6-2 lists the groups of fishes known to occur in the Study Area.

Table 3.6-1 lists the regulatory status and occurrence of ESA-listed fishes known to occur in the Study Area. Within the Study Area, eight fish species are listed as endangered or threatened under the ESA, of which three are anadromous (Atlantic salmon, Atlantic sturgeon, and Gulf sturgeon), one primarily inhabits its natal river and estuary (shortnose sturgeon); two primarily inhabit estuarine and coastal waters (largetooth sawfish and smalltooth sawfish); one that is generally considered a marine fish after early life stages in estuarine environments (scalloped hammerhead); and one that is fully deep-water marine (Nassau grouper). Additionally, there are two species proposed for ESA-listing (giant manta ray and oceanic whitetip shark), three ESA-candidates species (Alabama shad, cusk, and dwarf seahorse), and 14 species listed as Species of Concern. Fishes are protected by the ESA, the Magnuson-Stevens Fishery Conservation and Management Act, and the Sustainable Fisheries Act. Despite regulation, oversight, and technological improvements, the commercial fishing industry continues to have significant impacts on fish populations, including overfishing and bycatch of non-target species. The current aggregate impacts of past and present human activities are significant for some fish species, especially those that are globally in serious decline. Very few ocean habitats remain unaffected by human influence, and these stressors have shaped the condition of marine fish populations, particularly those species with large body size, late maturity ages, and/or low fecundity.

Section 3.6.2.1.4 (General Threats) includes an extensive discussion of the existing stressors, which often act on fish populations simultaneously, including habitat alteration (coastal development, deforestation, road construction, dam development, water control structures, and agricultural activities), exploitation and bycatch (commercial and recreational fisheries), vessel strikes, diseases and parasites (susceptibility and incidence increases with habitat alteration and exposure to individuals that escaped sea farms), introduction of non-native species, pollution (oil spills, marine debris, noise, hypoxia, and harmful algal blooms), and climate change. The additional threat of living in a noisy environment, such as produced by offshore wind energy developments, construction noise within inshore waters such as pile driving, sonar, seismic activity, shipping, and offshore construction projects, may contribute to cumulative stress as experienced by fish populations.

It is anticipated that the Proposed Action would affect fish species within the Study Area, including ESA-listed fish species. The analysis presented in Section 3.6 (Fishes) indicates that fishes could be affected by acoustic stressors (sonar and other transducers, air guns, pile driving, vessel noise, and weapons noise), explosives, energy stressors, physical disturbance or strikes (vessels and in-water devices, military expended materials, seafloor devices, pile driving), entanglement (wires and cables, decelerators/parachutes), and ingestion of military expended materials. The majority of potential impacts include short-term behavioral and physiological responses. For example, fish species that are exposed to sonar and other transducers within their hearing range or that are within close proximity to vessel or weapons noise may experience brief periods of masking or behavioral reactions, such as startle or avoidance responses, or no reaction at all. Other stressors (such as explosives) could also result in injury or mortality to a relatively small number of individuals. Overall, long-term consequences for most individual fishes or populations are unlikely because exposures from the majority of stressors are intermittent, transient, and unlikely to repeat over short periods. Some ESA-listed fish species that are known to occur within inshore water areas would be at higher risk during training and testing activities in these locations.

An individual fish could be exposed to a combination of stressors from multiple activities over the course of its life, and multiple stressors may have synergistic effects such as reducing its overall fitness and ability to quickly recover from additional, compounding stressors. If the health of an individual fish is compromised, it is possible this condition could alter the animal's expected response to stressors associated with the Proposed Action. Exposure to multiple stressors is most likely to occur in nearshore areas where training and testing activities are more concentrated and overlap the other nearshore stressors listed in Table 4.2-1 and Table 4.2-2. Likewise, animals with a home range intersecting concentrated Navy activities may be subjected to elevated exposure risks compared to those fishes that simply transit the area. Fishes that are malnourished, diseased, or experience temporary hearing loss, injury, or disorientation from acoustic stressors could suffer behavioral and physiological consequences such as decreased ability to detect and avoid predators, oncoming vessels, or entanglement risks.

The aggregate impacts of past, present, and other reasonably foreseeable future actions contributing multiple water quality, noise, and physical risks to fishes will likely continue to have significant effects on individual fishes and fish populations. However, Navy training and testing activities are generally isolated from other activities in space and time and the majority of the proposed training and testing activities occur in well known, previously established training range areas; are spatially distributed and not generally concentrated in any one location for any extended period of time; have few participants; and are of a short duration. Thus, although it is possible that the Proposed Action could contribute incremental stressors to a small number of individuals, which would further compound effects on a given individual already experiencing stress, it is not anticipated that the Proposed Action has the potential to put additional stress on entire populations. Therefore, it is anticipated that the incremental contribution of the Proposed Action, when added to the impacts of all other past, present and reasonably foreseeable future actions, would not result in measurable additional significant impacts on fishes in the Study Area or beyond.

4.4.7 Marine Mammals

4.4.7.1 Region of Influence

Four main types of marine mammals are generally recognized: cetaceans (whales, dolphins, and porpoises), pinnipeds (seals, sea lions, and walruses), sirenians (manatees and dugongs), and other marine carnivores (sea otters, marine otters, and polar bears). Table 3.7-1 lists the current abundance of marine mammal species that utilize the Study Area and describes the locations within the Study Area that they may be encountered. Populations are varied; whereas the average population of certain dolphin and some whale populations can exceed the hundreds of thousands, other stock populations are unknown or estimated to be in the hundreds. As with other marine resources, distribution is patchy and can be temporarily concentrated in specific areas depending on the species. The size and structures of these groups are dynamic and, based on the species, can range from several to several thousand individuals.

The general region of influence for marine mammals extends beyond the Study Area boundaries as for some species the Study Area represents only a portion of the full extent of the species' ranges during their lifecycle. Most of the baleen whales migrate great distances, while the toothed whales and dolphins have a smaller-scale, seasonal dispersal. Pinnipeds occur mostly in coastal habitats or over continental shelves. Manatees and polar bears are strongly associated with coastal waters as habitat for reproducing, resting, and, in some cases, feeding although polar bears can also range far offshore.

Activities are evaluated for their potential impact on individual marine mammals, on stocks and populations as appropriate, and on species or distinct population segments listed under the ESA.

4.4.7.2 Resource Trends

Relevant information on the status, distribution, population trends, and ecology is presented for each species and stock in the AFTT Study Area in Section 3.7.2 (Affected Environment). The current aggregate impacts of past human activities are significant for some marine mammal species, many of which were in serious decline across the world's oceans. A general summary in this regard is presented in Section 3.7.2.1.5 (General Threats). Other populations, such as the humpback whale, are increasing in abundance in much of their range (National Marine Fisheries Service, 2015b). All marine mammals in the U.S. are protected under the MMPA, and some species receive additional protection under the ESA. Of the 48 species of marine mammals known to exist within the Study Area, there are six populations listed as endangered under ESA and classified as strategic stocks under MMPA (bowhead whale, North Atlantic right whale, blue whale, fin whale, sei whale, and sperm whale), two are listed as threatened under ESA and classified as strategic stocks under the MMPA (West Indian manatee and polar bear), one is proposed for listing under the ESA (Bryde's whale), and the Artic ringed seal may be relisted as threatened under the ESA pending final judgement of the District Court for the District of Alaska. In addition, the pygmy sperm whale and some bottlenose dolphin stocks are classified as MMPA strategic stocks. Polar bears and Arctic ringed seals occur in a very limited portion of the Study Area and the locations where the majority of activities are proposed to occur do not overlap with those areas; thus, it is anticipated that the Proposed Action would have no effect on polar bears or the Arctic ringed seal and they are not discussed further in this cumulative effects analysis.

4.4.7.3 Impacts of Other Actions

4.4.7.3.1 Overview

Section 3.7.2.1.5 (General Threats to Marine Mammals) discusses the specific stressors within the affected environment that impact marine mammal populations in the Study Area, which include water quality degradation (chemical pollution), commercial industries (fisheries bycatch and other interactions), noise, hunting, vessel strike, power plant entrainment, disease and parasites, climate change, and marine debris. Potential impacts of actions that affect marine mammals include mortality, injury, disturbance, and reduced fitness, including reproductive, foraging, and predator avoidance success. The susceptibility of marine mammals to these outcomes often depends on proximity, severity, or vulnerability to the stressor, and vulnerability can be increased as multiple stressors compound on an individual. The abundance of the species in large part determines whether a fatality from any stressor would have population-level impacts on that species, and for species with small populations, such as the North Atlantic right whale, individual fatalities could have considerable population-level impacts (Laist et al., 2001).

Stranded marine mammals include alive or dead individuals that swim or float to shore and are incapable of returning to sea or individuals that have wandered outside of their "normal" habitat. Investigations of stranded marine mammals can provide indications of the general threats to marine mammals in a given location, and causes of strandings include navigation error, predator avoidance, population and climate shifts, infectious disease, parasite infestation, starvation, pollution exposure, trauma (e.g., injuries from ship strikes or fishery entanglements), sound (human-generated or natural), harmful algal blooms and associated biotoxins, tectonic events such as underwater earthquakes, and ingestion or interaction with marine debris (National Marine Fisheries Service, 2016a).

The activities as described in Table 4.2-1 each potentially contribute multiple stressors in the Study Area experienced by marine mammals, including vessel traffic, underwater noise, and water pollution. For example, most actions include the operation of marine vessels, which contribute to vessel strikes and underwater noise. Many of the actions also contribute underwater noise from sources other than vessels, including use of explosives for oil rig removal, seismic surveys, construction activities, and other military operations. Bycatch and entanglement, the main threats to marine mammal populations, are chiefly associated with fishing. Other threats or the synergistic effect of multiple stressors are unknown, such as the cause of the 2017 North Atlantic right whale Unusual Mortality Event that occurred throughout their range along the Atlantic coast (National Marine Fisheries Service, 2017). While Table 4.2-1 discusses these stressors for individual actions, their aggregate impacts specific to marine mammals are detailed in Section 3.7.2.1.5 (General Threats to Marine Mammals) and further described below. Data availability is inconsistent between species and activities, but quantitative estimations are presented where available.

4.4.7.3.2 Commercial Fishing and Entanglement

Past and present commercial fishing activities have had a profound effect on some marine mammal species and, despite continued improvements in bycatch avoidance and the implementation of regulatory efforts, fisheries interactions continue to be the primary human-related source of mortality for most marine mammal stocks (Knowlton et al., 2012; Roman et al., 2013; Van der Hoop et al., 2013). This mortality could result in or contribute to continued population declines for some species, including ESA-listed species such as the North Atlantic right whale.

4.4.7.3.2.1 Bycatch

Potential impacts from commercial fishing activities include marine mammal injury and mortality from bycatch, which refers to when animals are caught in commercial fishing operations targeting a different species. Total bycatch interactions are difficult to estimate as numbers are based on observations by NMFS staff or on numbers received from individual operations that self-report bycatch interactions. Although marine mammal bycatch has generally declined since the implementation of take reduction measures, and new management practices and regulatory oversight could result in future reductions, bycatch is expected to remain a leading cause of mortality for the reasonably foreseeable future (Geijer & Read, 2013; Hamer et al., 2010; Northridge, 2008; Read et al., 2006; Read, 2008).

Sixty-nine commercial fisheries, divided into groups defined by the type of gear, location, and/or target species for reporting purposes, operate in the Study Area (National Marine Fisheries Service, 2016b). In the Northern Atlantic Region (Maine to North Carolina) 6 fishery groups impact 13 marine mammal stocks. From 2011-2013 the average total marine mammal bycatch estimate in this region was 2,960 animals per year. Gillnet gear continues to be the largest contributor to total marine mammal bycatch, taking an average 2,102 and 386 animals annually in the New England and Mid-Atlantic fisheries, respectively. In 2013 these effects were as follows:

- Western North Atlantic gray seal (1,086 animals)
- Gulf of Maine/Bay of Fundy stock of harbor porpoise (640 animals)
- Western North Atlantic harbor seal (442 animals)
- Short-beaked common dolphin (287 animals)
- Western North Atlantic white-sided dolphin (116 animals).

In the Southeast Region (North Carolina through the Gulf of Mexico) one fishery (HMS pelagic longline) impacts two main species, short-finned pilot whales (Western North Atlantic) and bottlenose dolphins

(National Marine Fisheries Service, 2016a). From 2011-2013 the total marine mammal bycatch estimates from this fishery were 350, 293, and 145, respectively. In 2013 the total bycatch included 124 short-finned pilot whales and 62 bottlenose dolphins. Additionally, the bycatch rate of the shrimp otter trawl fishery is estimated to likely be exceeding 10% of the Potential Biological Removal for some marine mammal species, particularly various stocks of Gulf of Mexico common bottlenose and Atlantic spotted dolphins (Soldevilla et al., 2016). The Potential Biological Removal level is the number of animals that can be removed each year without preventing a stock from reaching or maintaining its optimal sustainable population-level.

The impacts of bycatch on marine mammal populations vary based on removal rates, population size, and reproductive rates. Small populations with relatively low reproductive rates are most susceptible. Bycatch rates for about 12 percent of United States marine mammal stocks (almost all cetaceans) exceed their Potential Biological Removal levels (Read, 2008).

The operations of fisheries also result in profound changes to the structure and function of marine ecosystems that adversely affect marine mammals, including loss of prey species and alteration of benthic structure. Overfishing of many fish stocks results in significant changes in trophic structure, species assemblages, and pathways of energy flow in marine ecosystems (Jackson et al., 2001; Myers & Worm, 2003). These ecological changes may have important, and likely adverse, consequences for populations of marine mammals (DeMaster et al., 2001). For instance, depletion of preferred prey could lead to a less nutritional diet and decreased reproductive success.

4.4.7.3.2.2 Entanglement and Ingestion

As discussed in Section 3.7.2.1.5 (General Threats to Marine Mammals), interactions between marine mammals and marine debris, including derelict fishing gear and plastics, are significant sources of injury and mortality (Baulch & Perry, 2014), and the percentage of marine mammal species with documented records of entanglement in or ingestion of marine debris increased from 43 to 66 percent between 1997 and 2015 (Bergmann et al., 2015). Ingestion of plastic bags and Styrofoam has been identified as a cause of injury or death of minke whales and deep-diving odontocetes, including beaked whales, pygmy sperm whales, and sperm whales. Manatee rescue records from 1993 to 2007 found that 27 percent of the cases were directly or indirectly associated with entanglement in or ingestion of marine debris, making entanglement and ingestion the top reason for rescuing manatees (Reinert et al., 2011). Table 4.4-1 provides entanglement data specific to baleen whales in the region of influence from 2010 through 2014 (Henry et al., 2016).

Table 4.4-1: Entanglements by Year: Summary of the Confirmed Human-Caused Mortality and Serious Injury Events Involving Baleen Whale Stocks along the Gulf of Mexico Coast, United States East Coast and Atlantic Canadian Provinces, 2010–2014

Stock	*Annual Injury and Mortality Rate (U.S. Waters / Canadian Waters / Unassigned Waters)*	*Confirmed Mortalities (2010, 2011, 2012, 2013, 2014)*	*Confirmed Injury Events (2010, 2011, 2012, 2013, 2014)*
Western North Atlantic Fin Whale	2.0 / 0 / 0	10 (2, 1, 4, 1, 2)	2 (1, 0, 0, 0, 1)
Gulf of Maine Humpback Whale[1]	1.8 / 0 / 0	9 (3, 3, 0, 2, 1)	13 (1, 4, 0, 3, 5)
Canadian East Coast Minke Whale	1.2 / 0.4 / 0	8 (1, 3, 1, 0, 3)	0
Western North Atlantic Right Whale	0.81 / 0 / 0.2	2 (1, 2, 0, 0, 0)	21 (4, 7, 6, 3, 1)
Nova Scotian Sei Whale	0.8 / 0 / 0	4 (0, 1, 0, 0, 3)	0
Unidentified Whale spp.	0.2 / 0.2 / 0	1 (1, 0, 0, 0, 0)	2 (0, 0, 1, 1, 0)
Northern Gulf of Mexico Bryde’s Whale	0 / 0 / 0	0	0
Western North Atlantic Blue Whale	0 / 0 / 0	0	0

[1] Excludes events involving confirmed members of a stock other than the Gulf of Maine feeding stock

[2] Opportunistic reports were provided by members of the U.S. and Canadian regional stranding networks, whale survey and disentanglement teams, the U.S. and Canadian Coast Guards, and the general public. With the exception of minke whales, the incidental takes of baleen whales recorded by fisheries observer programs are also included here as opportunistic reports because the numbers of observed takes were not sufficient to calculate bycatch rate estimates. All available information for each reported injury or mortality was collected by the NMFS Greater Atlantic Regional Fisheries Office, Southeast Regional Office, and Northeast Fisheries Science Center.

Source: Henry et al. (2016)

4.4.7.3.3 Maritime Traffic and Vessel Strikes

Maritime traffic has increased over the past 50 years, and vessel traffic is expected to continue to increase in the Study Area in response to continued economic globalization, widening of the Panama Canal, and increases in energy development and other offshore activities. While increased risks come with increased vessel traffic, risks of vessel strikes could be minimized by ongoing and future education and awareness, marine mammal reporting, ship speed reduction measures, and maritime traffic planning and management (e.g., Atlantic Coast Port Access Study (U.S. Coast Guard, 2016)). Within the AFTT Study Area, commercial vessel traffic is heaviest along the entire United States East Coast and along the northern coast of the Gulf of Mexico while Navy vessel traffic is primarily concentrated along the United States East Coast between the mouth of the Chesapeake Bay and Jacksonville, Florida (Mintz, 2012). An examination of vessel traffic within the AFTT Study Area determined that Navy vessel occurrence is two orders of magnitude lower than that of commercial traffic. The study also revealed that while commercial traffic is relatively steady throughout the year, Navy vessel usage is episodic and based on specific exercises being conducted at different times of the year (Mintz, 2012); however, Navy vessel use within inshore waters occurs regularly and routinely consists of high-speed small vessel movements.

Most reported marine mammal vessel strikes involve commercial vessels and occur over or near the continental shelf (Laist et al., 2001). However, West Indian manatees are very susceptible to vessel strikes within inshore and coastal waters due to the overlap with their distribution and high levels of small vessel traffic, making vessel strike the leading anthropogenic cause of manatee mortality (Rommel et al., 2007). The most vulnerable marine mammals are thought to be those that spend extended periods at the surface or species whose unresponsiveness to vessel sound makes them more susceptible to vessel collisions (Gerstein, 2002; Laist & Shaw, 2006; Nowacek et al., 2004). Marine mammals such as dolphins, porpoises, and pinnipeds that can move quickly throughout the water column are not as susceptible to vessel strikes.

The following percentage of strikes by species were observed during the period from 1995 through 2011 (National Marine Fisheries Service, 2011a): humpback whale (28 percent), North Atlantic right whale (19 percent), fin whale (17 percent), unknown species (16 percent), sei whale (6 percent), minke whale (5 percent), Cuvier's beaked whale (3 percent), Bryde's whale (2 percent), sperm whale (2 percent), Blainville's beaked whale (1 percent), and Gervais' beaked whale (1 percent). West Indian manatees are also highly susceptible to boat strikes, but the data were not readily available to calculate a comparable percentage. Vessel strike data for tracked baleen whale stocks in the region of influence from 2010 to 2014 are provided in Table 4.4-2.

Table 4.4-2: Vessel Collisions by Year: Summary of the Confirmed Human-Caused Mortality and Serious Injury Events Involving Baleen Whale Stocks along the Gulf of Mexico Coast, United States East Coast and Atlantic Canadian Provinces, 2010–2014[2]

Stock	*Annual Injury and Mortality Rate (U.S. Waters /Canadian Waters / Unassigned Waters)*	*Confirmed Mortalities (2010, 2011, 2012, 2013, 2014)*	*Confirmed Injury Events (2010, 2011, 2012, 2013, 2014)*
Western North Atlantic Fin Whale	2.0 / 0 / 0	10 (2, 1, 4, 1, 2)	2 (1, 0, 0, 0, 1)
Gulf of Maine Humpback Whale[1]	1.8 / 0 / 0	9 (3, 3, 0, 2, 1)	13 (1, 4, 0, 3, 5)
Canadian East Coast Minke Whale	1.2 / 0.4 / 0	8 (1, 3, 1, 0, 3)	0
Western North Atlantic Right Whale	0.81 / 0 / 0.2	2 (1, 2, 0, 0, 0)	21 (4, 7, 6, 3, 1)
Nova Scotian Sei Whale	0.8 / 0 / 0	4 (0, 1, 0, 0, 3)	0
Unidentified Whale spp.	0.2 / 0.2 / 0	1 (1, 0, 0, 0, 0)	2 (0, 0, 1, 1, 0)
Northern Gulf of Mexico Bryde's Whale	0 / 0 / 0	0	0
Western North Atlantic Blue Whale	0 / 0 / 0	0	0

[1] Excludes events involving confirmed members of a stock other than the Gulf of Maine feeding stock

[2] Opportunistic reports were provided by members of the U.S. and Canadian regional stranding networks, whale survey and disentanglement teams, the U.S. and Canadian Coast Guards, and the general public. With the exception of minke whales, the incidental takes of baleen whales recorded by fisheries observer programs are also included here as opportunistic reports because the numbers of observed takes were not sufficient to calculate bycatch rate estimates. All available information for each reported injury or mortality was collected by the NMFS Greater Atlantic Regional Fisheries Office, Southeast Regional Office, and Northeast Fisheries Science Center.

Source: Henry et al. (2016)

4.4.7.3.4 Ocean Noise

Ocean noise as a general stressor in modern oceans is described in Table 4.2-2 and specific to marine mammals in Section 3.7.2.1.5 (General Threats). Noise is of particular concern to marine mammals because many species use sound as a primary sense for navigating, finding prey, avoiding predators, and communicating with other individuals. Noise can cause behavioral disturbances; mask other sounds (including their own vocalizations); and may result in injury, including hearing loss in the form of temporary threshold shift (TTS) or permanent threshold shift (PTS) and, in some cases, death.

Anthropogenic noise is generated from a variety of sources throughout the region of influence, including commercial shipping, oil and gas exploration and production activities (including air gun, drilling, and explosive decommissioning), commercial and recreational fishing (including vessel noise, fish-finding sonar, fathometers, and acoustic deterrent and harassment devices), shoreline construction projects (including pile driving), recreational boating and whale-watching activities, offshore power generation (including offshore windfarms), and research (including sound from air guns, sonar, and telemetry).

The military activities addressed in Table 4.2-1 include various training and testing operations that contribute vessel noise, underwater and surface explosions, and sonar. Use of mid-frequency sonar between 1950 and 2001 has been correlated with 12 of 126 beaked whale mass strandings during five separate exercises (U.S. Department of the Navy, 2017b). Of these exercises, four were multi-nation (North Atlantic Treaty Organization countries) and one was solely an U.S. Navy exercise occurring near the Bahamas. In the Bahamas event, seven stranded animals died, and ten returned to the water. Although sonar activity has historically been correlated to various negative impacts on marine mammals, with the implementation of required mitigation measures, sonar operations are not expected to result in mortality to any stock of marine mammals and minimal injury or behavioral changes are anticipated. Although various other military training and testing activities involve surface or undersea detonations or gunnery exercises, these are generally mitigated through monitored exclusion zones, and are infrequent, isolated events. As described in Table 4.2-1, many activities incorporate best management practices or standard operating procedures to minimize noise generation. Likewise, any in-water construction that may occur at naval piers would utilize dampening and attenuation technologies and other practices that reduce impacts on bottlenose dolphins and other sensitive receptors in the vicinity of pile driving activities.

4.4.7.3.5 Ocean Pollution

As discussed in Table 4.2-1 and Table 4.2-2, multiple pollutants from multiple sources are present in, and continue to be released into, the oceans. Section 3.7.2.1.5 (General Threats to Marine Mammals) provides an overview of these potential impacts, which include morbidity and mortality from acute toxicity; disruption of endocrine cycles and developmental processes causing reproductive failures or birth defects; suppression of immune system function; and metabolic disorders resulting in cancer or genetic abnormalities (Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016). The effects of exposure to and concentration of persistent organic pollutants in marine mammals, especially from pesticides, includes the accumulation of dichlorodiphenyltrichloroethane and polychlorinated biphenyls in certain species, and high concentrations of organochlorines in tissues appear to have occurred with increasing frequency among marine mammals infected with secondary diseases. In addition, experimental and other evidence has shown that persistent contaminants often found in the tissues of marine mammals have deleterious effects on reproduction and the immune system (O'Shea et al., 1999).

The Deepwater Horizon oil spill is associated with an Unusual Mortality Event that killed over 1,000 marine mammals between 2010 and 2014. The majority of affected mammals are bottlenose and other dolphins but the spill has also impacted the Gulf of Mexico stock of sperm, Blainville's, Cuvier's, and Gervais' beaked whales and the Northern Gulf of Mexico stocks of Byrd's, short-finned pilot, melon-headed, pygmy and false killer, and dwarf and pygmy sperm whales, off the coasts of Louisiana, Alabama, and Mississippi since the spill occurred (National Oceanic and Atmospheric Administration, 2017b). Although marine mammal deaths associated with the spill were highest during this period, many populations continue to experience chronic illnesses and mortalities related to the spill (National Marine Fisheries Service, 2018a).

4.4.7.3.6 Power Plant Entrainment

Coastal power plants use seawater as a coolant during power plant operation. Intakes into these plants can sometimes trap (i.e., entrain) marine animals that swim too close to the intake pipe. Power plant entrainment contributes to human-related mortalities for gray seals. Conversely, Florida manatees rely on warm-water refuges typically associated with warm-water discharges from coastal power plants for winter habitats.

4.4.7.3.7 Disease, Parasites, and Algae

Section 3.7.2.1.5.3 (Disease and Parasites) discusses the effects of disease and parasites in marine mammals. Just like humans, older animals are more susceptible to disease, and disease can spread through a population affecting a significant number of otherwise healthy individuals. Mass bottlenose dolphin die-off events have occurred since July 2013 along the Atlantic coast due to cetacean morbillivirus. Additionally, the spread of certain parasites (toxoplasmosis, hookworms, lungworms, and thorny-headed worms) can cause serious health issues and death, especially if multiple stressors have decreased the potential immunity and resilience of a given individual. Mortalities can also occur as a result of toxic algal blooms, such as the 2008 *Alexandrium tamarense* algal bloom that resulted in unprecedented mass mortalities of fish, birds, and marine mammals and *Karenia brevis* blooms affecting bottlenose dolphins and Florida manatee in the Gulf of Mexico and along the Florida Atlantic coast.

4.4.7.4 Impacts of the Proposed Action That May Contribute to Cumulative Impacts

Impacts of the Proposed Action are detailed in Section 3.7 (Marine Mammals). Impacts that may contribute to cumulative impacts on marine mammals can be generally categorized as mortality, injury (Level A harassment under the MMPA), and behavioral responses and TTS (Level B harassment under the MMPA). These impacts would be associated with certain acoustic (sonar and other transducers), physical disturbance, and strike stressors. Although behavioral impacts are possible from the remaining acoustic stressors (noise from air guns, weapons firing/launch/impact, aircraft, and vessels), energy stressors (in-water electromagnetic devices and high energy lasers), physical disturbance and strike stressors (in-water devices, military expended materials, and seafloor devices), entanglement stressors (wires and cables, decelerators/parachutes, and biodegradable polymers), ingestion stressors (munitions and military expended materials other than munitions), and secondary stressors, these stressors are not expected to result in behavioral harassment, TTS, PTS, injury, or mortality of marine mammals.

The analysis presented in Section 3.7 (Marine Mammals) concluded that some stressors associated with the Proposed Action could impact individuals of certain marine mammal species, but impacts are not expected to decrease the overall fitness of any marine mammal population. Species most likely to be impacted by training and testing activities are those that are most abundant in the Study Area, primarily including the common dolphin, Atlantic spotted dolphin, striped dolphin, bottlenose dolphin, clymene dolphin, harbor porpoise, Atlantic white-sided dolphin, Risso's dolphin, pantropical spotted dolphin, and pilot whale that have stocks with tens to hundreds of thousands of animals. From a cumulative perspective, any potential impacts on species with small populations, especially ESA-listed species such as the North American right whale, are of particular concern, and the Navy has consulted with the NMFS, as required by section 7(a)(2) of the ESA, in that regard. The Navy will implement mitigation to avoid impacts from acoustic, explosive, and physical disturbance and strike stressors on marine mammals, as described in Chapter 5 (Mitigation).

As determined in Section 3.7.4 (Summary of Potential Impacts on Marine Mammals), it is not anticipated that the Proposed Action will result in measurable impacts to marine mammal populations. The majority of the proposed activities are unit level training and small testing activities, which are conducted in the open ocean. Unit level events occur over a small spatial scale (one to a few square miles) and with few participants (usually one or two) or short duration (the order of a few hours or less). Additionally, training and testing activities are generally separated in space and time in such a way that it would be unlikely that any individual marine mammal would be exposed to stressors from multiple Navy activities within a short timeframe. Furthermore, research and monitoring efforts have included before, during, and after-event observations and surveys; data collection through conducting long-term studies in areas of Navy activity; occurrence surveys over large geographic areas; biopsy of animals occurring in areas of Navy activity; and tagging studies where animals are exposed to Navy stressors. To date, the findings from the research and monitoring (U.S. Department of the Navy, 2017b) and the regulatory conclusions from previous analyses by NMFS (National Marine Fisheries Service, 2015a; National Oceanic and Atmospheric Administration, 2013) are that the majority of Navy training and testing activities are not expected to have deleterious impacts on the fitness of any individuals or long-term consequences to populations of marine mammals.

4.4.7.4.1 Mortality

NMFS has previously concluded that the use of sonar and other transducers under the Proposed Action is possible but not expected to result in marine mammal mortality (National Marine Fisheries Service, 2015a; National Oceanic and Atmospheric Administration, 2013). Mitigation measures discussed in Chapter 5 (Mitigation) are designed to avoid potential impacts of explosives, especially higher-order impacts such as injury and death. However, the acoustic analysis indicates that certain marine mammal species could be exposed to underwater pressure waves from explosive detonations that may lead to mortality (Tables 3.4-26 through 3.4-33). The protections afforded by mitigation measures cannot be fully quantified. For a general discussion of strandings and their causes, as well as strandings in association with U.S. Navy activity, see the technical report titled Marine Mammal Strandings Associated with U.S. Navy Sonar Activities (U.S. Department of the Navy, 2017b).

Abundant species including the common dolphin, Atlantic spotted dolphin, striped dolphin, bottlenose dolphin, clymene dolphin, harbor porpoise, Atlantic white-sided dolphin, Risso's dolphin, pantropical spotted dolphin, and pilot whale could have the highest chance of being killed by an explosion. The acoustic analysis also suggests that small numbers (three or less) of minke whales, melon-headed whales, white-beaked dolphins, spinner dolphins, and the ESA-listed sperm whale could be exposed to pressure waves from explosive detonations that may lead to mortality (Tables 3.4-22 through 3.4-29). Potentially lethal impacts were not predicted for other ESA-listed marine mammals.

Large ship shock trials occurring once per five-year period and small ship shock trials occurring three times per five-year period represent the greatest risk for marine mammal mortality based on the high net explosive weight charges used during these testing activities (up to 58,000 lb. net explosive weight). These testing events may occur in the Virginia Capes OPAREA, the Jacksonville OPAREA, or the Gulf of Mexico OPAREA in waters deeper than 650 feet. Specific mitigation measures discussed in Chapter 5 (Mitigation) would be applied during shock trials and would greatly lower the likelihood of killing or injuring any marine mammals. If mortality were to occur, it is likely that the affected individuals would be from delphinid stocks or populations that number in the tens of thousands of animals.

Vessel strikes could also result in mortality of certain marine mammal species under the Proposed Action. Based on historical records and the probability analysis presented in Section 3.7.3.4 (Physical Disturbance and Strike Stressors), the Navy predicts that large whales may potentially be struck by a large vessel as a result of training and testing activities in the offshore portion of the Study Area. While the species involved in a strike cannot be quantifiably predicted, the affected animals may include the following species: fin whale, minke whale, sei whale, sperm whale, blue whale, or beaked whales. The Navy does not anticipate it would strike a North Atlantic right whale or West Indian manatee. For small vessel use within inshore waters, there have been zero reported strikes; therefore, the Navy predicts that no marine mammals would be struck by small vessels.

4.4.7.5 Cumulative Impacts on Marine Mammals

In general, bycatch, vessel strikes, and entanglement are leading causes of injury and direct mortality to marine mammals throughout the region of influence. Although mitigated to the greatest extent practicable, the Proposed Action could result in injury and mortality to individuals of some marine mammal species from underwater explosions and vessel strikes, and potential auditory injury (i.e. PTS) from sonar. Implementation of measures discussed in Chapter 5 (Mitigation) would help avoid, but not absolutely eliminate, the risk for potential impacts, and any incidence of injury and mortality that might occur under the Proposed Action could be additive to injury and mortality associated with other actions in the region of influence. While it is more likely that an individual of an abundant, common stock or species would be affected, there is a chance that a less abundant stock could be affected.

Ocean noise is already significantly elevated over historic, natural levels, and acoustic stressors (underwater explosions and sonar as well as increased Navy vessel noise) associated with the Proposed Action could also result in additive acoustic impacts on marine mammals. However, sonar is known to be neither a major threat to marine mammal populations nor a significant portion of the overall ocean noise budget (Bassett et al., 2010; Baumann-Pickering et al., 2010; International Council for the Exploration of the Sea, 2005; McDonald et al., 2006). Other current and future actions such as construction and operation of liquefied natural gas terminals; characterization, construction, and operation of offshore wind energy projects; seismic surveys; and construction, operation, and removal of oil and gas facilities could result in underwater sound levels that could cause behavioral harassment, TTS, PTS, or injury. Additionally, the constant elevation in ambient noise may produce physiological stress in individuals to which the Proposed Action would contribute.

Sounds from many of these sources travel over long distances, and it is possible that some would overlap in time and space with sounds from underwater explosions or Navy sonar use, in particular distant shipping noise, which is more widespread and continuous. It is not known whether the co-occurrence of shipping noise and sounds associated with underwater explosions and sonar use would result in harmful additive impacts on marine mammals. However, these activities are widely dispersed, the sound sources are intermittent, and mitigation measures would be implemented. Furthermore, safety, security, and operational considerations would preclude some training and testing activities in the immediate vicinity of other actions, further reducing the likelihood of simultaneous or overlapping exposure. For these reasons, it is unlikely that an individual marine mammal would be simultaneously exposed to sound levels from multiple actions that could cause behavioral harassment, TTS, PTS, or injury.

If the health of an individual marine mammal were compromised, it is possible this condition could alter the animal's expected response to stressors associated with the Proposed Action. The behavioral and physiological responses of any marine mammal to a potential stressor, such as underwater sound, could be influenced by various factors, including disease, dietary stress, body burden of toxic chemicals, energetic stress, percentage body fat, age, reproductive state, and social position. Synergistic impacts are also possible; for example, animals exposed to some chemicals may be more susceptible to noise-induced loss of hearing sensitivity (Fechter & Pouyatos, 2005). While the response of a previously stressed animal might be different from the response of an unstressed animal, no data is available at this time to accurately predict how stress caused by various ocean pollutants would alter a marine mammal's response to stressors associated with the Proposed Action.

In summary, the aggregate impacts of past, present, and other reasonably foreseeable future actions continue to have significant impacts on some marine mammal species in the Study Area. The Proposed Action could contribute incremental stressors to individuals, which would further compound effects on a given individual already experiencing stress. However, with the implementation of standard operating procedures reducing the likelihood of overlap in time and space with other stressors and the implementation of mitigation measures reducing the likelihood of impacts, the incremental stressors anticipated from the Proposed Action are not anticipated to be significant.

Furthermore, the regulatory process administered by NMFS, which includes Stock Assessments for all marine mammals and a 5-year reviews for all ESA-listed species, provides a backstop that informs decisions on take authorizations and Biological Opinions. Stock Assessments include estimates of Potential Biological Removal that stocks of marine mammals can sustainably absorb. MMPA take authorizations require that the proposed action have no more than a negligible impact on species or stocks, and that the proposed action imposes the least practicable adverse impact on the species. MMPA authorizations are reinforced by monitoring and reporting requirements so that NMFS is kept informed of deviations from what has been approved. Biological Opinions for federal and non-federal actions are similarly grounded in status reviews and conditioned to avoid jeopardy and to allow continued progress toward recovery. These processes help to ensure that, through compliance with these regulatory requirements, the Navy's Proposed Actions would not have a measurable effect on the resource.

4.4.8 Reptiles

4.4.8.1 Region of Influence

The general region of influence for reptiles is the open ocean and coastal regions throughout the tropical to temperate latitudes of the Study Area. Reptiles that occur within the boundaries of the Study Area include sea turtles (green turtles [*Chelonia mydas*], hawksbill turtle [*Eretmochelys imbricate]*, Kemp's ridley turtle [*Lepidochelys kempii*], leatherback turtle [*Dermochelys coriacea]*, and loggerhead turtle [*Caretta caretta*]) and crocodilians (the American crocodile [*Crocodylus acutus*], the American alligator [*Alligator mississippiensis*]), and various subspecies of diamondback terrapin (*Malaclemys terrapin*) In general, sea turtles spend most of their time at sea, with female turtles returning to land to nest and often migrating long distances between feeding grounds and nesting beaches. Alligators and crocodiles spend most of their time in fresh or brackish water, with individuals occasionally briefly sighted in nearshore marine waters, and terrapin generally occupy brackish swamps along the Atlantic and Gulf coasts. As with other marine resources, reptile distribution is patchy and can be concentrated in specific areas depending on the species, season, habitat, activity, and age of the individuals.

4.4.8.2 Resource Trends

All reptiles in the Study Area have experienced significant decline in population numbers over the past hundred years and are ESA-listed (Table 3.8-1). Because turtles are so long-lived, and because reliable data is only available for approximately the past 20 years, it is not possible to determine a reliable trend in abundance for most species; however, recent data show an increase in nesting trends within the Study Area (Mazaris et al., 2017). Since listing, alligator and crocodile populations are recovering in the U.S. and distributions have expanded; alligator populations have largely rebounded but are still protected under the ESA due to their similarity in appearance to crocodiles.

4.4.8.3 Impacts of Other Actions

4.4.8.3.1 Overview

Section 3.8.2.1.5 (General Threats) discusses the specific stressors within the affected environment that impact sea turtle populations in the Study Area, which include water quality (marine debris and chemical contaminants), commercial industries (fisheries bycatch and other interactions, hunting/exploitation, vessel strike, oil and gas development, wind and hydrokinetic energy development, shoreline development and recreation, dredging, military activities, invasive species, disease, habitat destruction (loss of seagrass habitat and nesting beaches), and climate change. Potential impacts of actions that affect reptiles include mortality, injury, disturbance, and reduced fitness, including reproductive, foraging, and predator avoidance success. Crocodiles are largely impacted by habitat loss, specifically coastal development in Florida that restricts breeding areas as well as freshwater flow into swamps and estuaries. Car collisions and competition and predation pressure from introduced species are also threats. Alligators are sensitive to prey availability and water quality parameters, including metal and pharmaceutical contamination.

The susceptibility of sea turtles to these outcomes often depends on proximity, severity, or vulnerability to the stressor, and vulnerability can be increased as multiple stressors compound on an individual. The abundance of the species, potential impacts that may affect localized nesting locations (e.g., Kemp's ridley nesting in the Gulf of Mexico), and individual fatalities could have considerable impacts in localized populations.

The activities described in Table 4.2-1 each potentially contribute multiple stressors in the Study Area experienced by reptiles, including vessel traffic, underwater noise, and water pollution. For example, most actions include the operation of marine vessels, which contribute to vessel strikes and underwater noise. Many of the actions also contribute underwater noise from sources other than vessels, including use of explosives for oil rig removal, seismic surveys, construction activities, and military operations. Bycatch and entanglement, among the main threats to reptile populations in the Study Area, are chiefly associated with fishing and are discussed separately. While Table 4.2-1 and Table 4.2-2 discuss these stressors for individual actions, their aggregate impacts specific to reptiles are detailed in Section 3.8.2.1.5 (General Threats) and further described below.

4.4.8.3.2 Commercial Fishing and Harvest

Past and present commercial fishing activities have had a profound global effect on the recovery and conservation of marine turtle populations and, despite continued improvements in bycatch avoidance and the implementation of regulatory efforts, fisheries interactions continue to be the primary human-related source of mortality for most sea turtles (National Research Council of the National Academies, 1990; Wallace et al., 2010). One comprehensive study estimated that worldwide, 447,000 turtles are killed each year from bycatch in commercial fisheries (Wallace et al., 2010). Among fisheries that incidentally capture sea turtles, certain types of trawl, gillnet, and longline fisheries generally pose the greatest threat. NMFS has instituted fishery observer and documentation programs to record bycatch events and implements regulations to reduce sea turtle bycatch in the Pacific and Atlantic Oceans and the Gulf of Mexico. In the Atlantic and Gulf of Mexico, NMFS requires gear modifications, changes to fishing practices, and time/area closures to reduce sea turtle bycatch in specific fisheries, especially the use of turtle excluder devices by the trawl fishing industry in the southeastern U.S. Atlantic and Gulf of Mexico. NMFS maintains a collaborative bycatch reduction engineering program that focuses on the innovation of efficient and economically effective bycatch and interaction strategies in federally managed fisheries.

In the region of influence for sea turtles, three fishery groups comprised of 13 individual fisheries impact loggerhead, leatherback, green, and Kemp's Ridley (National Marine Fisheries Service, 2016a). Fisheries that result in sea turtle bycatch in the Study Area include pelagic fisheries for swordfish, tuna, shark, and billfish; purse seine fisheries for tuna; commercial and recreational rod and reel fisheries; gillnet fisheries for shark; driftnet fisheries; bottom longline fisheries; and sea scallop fisheries (National Marine Fisheries Service, 2009a). NMFS has determined that Southeast shrimp trawl fisheries, Atlantic HMS pelagic longline, HMS directed shark, reef fish, and coastal migratory pelagic resources fisheries have been found likely to adversely affect threatened and endangered sea turtles (National Marine Fisheries Service, 2014b).

However, the fisheries that have the most significant demographic effect on sea turtles are the shrimp trawl fisheries conducted off the southeast U.S. (from North Carolina to the Atlantic coast of Florida) and Gulf of Mexico (from the Gulf coast of Florida to Texas). Since 1994 all shrimp trawling participants are required to use turtle exclusion devices, which, when used, are estimated to reduce the number of sea turtles trawlers capture by as much as 94-97 percent (National Marine Fisheries Service, 2014b). However, from 2012 to 2013 use ranged from 58 to 83 percent on vessels boarded (National Marine Fisheries Service, 2014b). During this time, interactions between Southeastern shrimp fisheries and sea turtles were estimated to effect 663,636 individual sea turtles, including 527,842 interactions and 43,622 mortalities. The majority of individuals affected are Kemp's Ridley.

Globally, large-scale commercial exploitation also contributes to global decline in sea turtle populations. Currently, 42 countries and territories allow direct take of turtles and collectively take in excess of 42,000 turtles per year, the majority of which (greater than 80 percent) are green turtles (Humber et al., 2014). Illegal fishing for sea turtles and nest harvesting also continues to be a major cause of sea turtle mortality, both in countries that allow sea turtle take and in countries that outlaw the practice (Lam et al., 2011; Maison et al., 2010). For example, Humber et al. (2014) estimated that in Mexico 65,000 sea turtles were illegally harvested between 2000 and 2014. The authors, however, have seen legal and illegal direct take of sea turtles trending downward over the past three decades—citing a greater than 40 percent decline in green sea turtle take since the 1980s, a greater than 60 percent decline in hawksbill and leatherback take, and a greater than 30 percent decline in loggerhead take (Humber et al., 2014).

4.4.8.3.2.1 Maritime Traffic and Vessel Strikes

Maritime traffic has increased over the past 50 years, and vessel traffic is expected to continue to increase in the Study Area in response to continued economic globalization, widening of the Panama Canal, and increases in energy development and other offshore activities. Vessel strike has been identified as one of the important mortality factors in several nearshore turtle habitats worldwide. Precise data are lacking for sea turtle mortalities directly caused by ship strikes; however, live and dead turtles are often found with deep cuts and fractures indicative of collision with a boat hull or propeller (Hazel et al., 2007; Lutcavage et al., 1997). For example, scientists in Hawaii reported that 2.5 percent of green turtles found dead on the beaches between 1982 and 2003 had been killed by boat strike (Chaloupka et al., 2008), and in the Canary Islands, 23 percent of stranded sea turtles showed lesions from boat strikes or fishing gear (Oros et al., 2005). Denkinger et al. (2013) reports that boat strikes in the Galapagos Islands were most frequent at foraging sites close to a commercial and tourism port.

The Sea Turtle Stranding and Salvage Network includes federal, state and private partners who document sea turtle strandings along the U.S. Gulf of Mexico and Atlantic coasts from Maine to Texas and portions of the U.S. Caribbean (National Oceanic and Atmospheric Administration, 2017a). Network participants compile records of vessel interactions (propeller injury) from their respective areas and contribute those data to the centralized Sea Turtle Stranding and Salvage Network database on a weekly basis (National Oceanic and Atmospheric Administration, 2017a). For the Gulf of Mexico and Atlantic regions, the Sea Turtle Stranding and Salvage Network recorded 2,055 total nearshore and offshore strandings in 2016. (Louisiana had minimal participation in this program.)

Some vessel strikes could cause temporary impacts, such as diverting the turtle from its previous activity or causing minor injury. Major strikes could cause permanent injury or death from bleeding, infection, or inability to feed. Apart from the severity of the physical strike, the likelihood and rate of a turtle's recovery from a strike may be influenced by its age, reproductive state, and general condition. Numerous living sea turtles bear scars that appear to have been caused by propeller cuts or collisions with vessel hulls (Hazel et al., 2007; Lutcavage et al., 1997), suggesting that not all vessel strikes are lethal. While increased risks come with increased vessel traffic, risks of vessel strikes could be minimized by ongoing and future education and awareness, ship speed reduction measures, and maritime traffic planning and management (e.g. Atlantic Coast Port Access Study (U.S. Coast Guard, 2016)).

4.4.8.3.3 Coastal Land Development

The population along the U.S. coastline grew from 47 million in 1960 to 87 million in 2008, and human development now dominates the coastline almost continuously throughout its extent (Wilson & Fischetti, 2010). During this timeframe, the Atlantic coast grew by 15 million people and the Gulf of Mexico about 8 million. Although this represents 56 percent growth for the Atlantic region, the Gulf of Mexico, which prior to the 1960s was more rural, grew 150 percent during that timeframe. The limited space for development in coastal areas results in greater population density in these locations. In the U.S. (excluding Alaska), non-coastal counties average 98 persons per square mile while coastal counties average 300 persons per square mile.

Female sea turtles migrate to their natal beaches to lay eggs, and pervasive coastal development often interferes with successful nesting at these locations. Shared use between turtles and human interests on increasingly populated and utilized beach areas has intensified the tendency for female turtles and their hatchlings to encounter various barriers and hazards accessing, nesting, and leaving these beaches. Beachfront construction of homes, hotels, restaurants, and roads; seawall construction, shoreline armoring, and beach erosion; ports and marinas; beach replenishment; nearshore dredging; and oil and gas activities can all prevent beach access and emigration; beach-going vehicles and watercraft cause injury and mortality; and abandoned debris and equipment are often insurmountable obstacles for both mother and offspring (SeeTurtles.org, 2017). Populated areas also often have excess nighttime lighting that confuses hatchlings' instincts to orient toward the moon to arrive at the ocean, and in this journey they often fall into and can remain trapped within pits and scars left on the beach. Conservation awareness has increased on many popular U.S. beaches and tourist destinations, but nesting success remains imperiled in many others. Along the Atlantic coast, development can also lead to secondary impacts, such as barrier island migration induced by altering sediment loads into coastal environments. For example, landward barrier island migration is occurring at about 1–6 meters per year, which is leading to back barrier area reduction and large-scale salt marsh loss (0.45 km2 per year) (Deaton et al., 2017). This process is responsible for 51 percent of the marsh loss in the Atlantic coastal region.

Human development along coastal zones is also a major threat to crocodilian species and terrapin as development diminishes available habitat and restricts the species' breeding range. In addition to direct habitat loss, alteration of habitat is a concern; typically, residential and urban development restricts freshwater flow into swamps and estuaries, which may in particular limit crocodilian growth, survival, and abundance (Mazzotti et al., 2007).

4.4.8.3.4 Ocean Pollution

As discussed in Table 4.2-1 and Table 4.2-2, multiple pollutants from multiple sources are present in, and continue to be released into, the oceans. Section 3.8.2.1.5.1 (Water Quality) provides an overview of these potential impacts on sea turtles, which include the ingestion of and entanglement in marine debris as well as toxicity from bisphenol-A, phthalates, and heavy metals. Sea turtles often mistake debris for prey; one study found 37 percent of dead leatherback turtles had ingested various types of plastic (Mrosovsky et al., 2009). Other marine debris, including derelict fishing gear and cargo nets, can entangle and drown turtles in all life stages.

A total of 1,146 sea turtle mortalities were recorded during the 2010 Deepwater Horizon Oil Spill, most of which were Kemp's Ridley (National Marine Fisheries Service, 2011b, 2014a). The available data on sea turtle strandings and response collections during the time of the spill are expected to represent a fraction (currently unknown) of the actual losses to the species, as most individuals likely were not recovered. Indirect effects from the spill include loss of seagrass foraging habitat and other food species. Long-term effects of oil spills can persist for decades (National Marine Fisheries Service, 2011b, 2014a; Ortmann et al., 2012).

4.4.8.3.5 Ocean Noise

Ocean noise as a general stressor in modern oceans is described in Table 4.2-2. Anthropogenic noise is generated from a variety of sources throughout the region of influence, including commercial shipping, oil and gas exploration and production activities (including air guns, drilling, and explosive decommissioning), commercial and recreational fishing (including vessel noise, fish-finding sonar, fathometers, and acoustic deterrent and harassment devices), shoreline construction projects (including pile driving), recreational boating and whale-watching activities, offshore power generation (including offshore windfarms), and research (including sound from air guns, sonar, and telemetry). The military activities addressed in Table 4.2-1 include various training and testing activities that also contribute vessel noise, underwater and surface explosions, and sonar; however, due to the low risk of encounter and the implementation of required mitigation measures, sonar operations are not expected to result in mortality to any sea turtles and only minimal injury or behavioral changes are anticipated. Although various other military training and testing activities involve surface or underwater detonations or gunnery exercises, these are generally mitigated through monitored exclusion zones, and are infrequent and isolated events. Further, as described in Section 3.0.3.3.1.4 (Vessel Noise), it is estimated that the overall contribution of Navy vessel noise is less than 1 percent of the overall total vessel broadband noise in the entire AFTT study area.

In general, the potential concerns associated with ocean noise and sea turtles are not as well defined as those for marine mammals. While it is well known that many species of marine mammals use sound as a primary sense for navigating, finding prey, and communicating with other individuals, little is known about how sea turtles use sound in their environment. Based on knowledge of their sensory biology (Bartol & Musick, 2003; Bartol & Ketten, 2006; Ketten & Moein-Bartol, 2006; Levenson et al., 2004), sea turtles may be able to detect objects within the water column (e.g., vessels, prey, predators) via some combination of auditory and visual cues. However, research examining the ability of sea turtles to avoid collisions with vessels shows they may rely more on their vision than auditory cues (Hazel et al., 2007). Similarly, while sea turtles may rely on acoustic cues from breaking waves to identify nesting beaches, they also appear to rely on other nonacoustic cues for navigation, such as magnetic fields (Lohmann & Lohmann, 1992, 1996) and light (Avens, 2003). Additionally, sea turtles are not known to produce sounds underwater for communication. As a result, sound may play a limited role in a sea turtle's environment.

Nonetheless, as discussed in Section 3.8.3.1 (Acoustic Stressors), sea turtles could experience a range of impacts from ocean noise, depending on the sound source. The impacts could include permanent or temporary hearing loss, changes in behavior, physiological stress, and auditory masking. In addition, potential impacts from use of explosives could range from physical discomfort to nonlethal and lethal injuries.

4.4.8.3.6 Offshore Energy Development

Offshore energy development, including oil and natural gas extraction in coastal and deep waters on the continental shelf and renewable energy projects, can degrade sea turtle habitats during pre-construction, construction, and operation phases. Prior to any drilling or driving operations, vessel traffic and seismic disturbances through exploration activities can degrade sea turtle coastal and open ocean foraging habitats. Oil and gas exploration and development in the Gulf of Mexico are a particular threat to Kemp's Ridley sea turtles. Sea turtles are also frequently observed in areas identified for renewable energy development along the mid-Atlantic coast, although the potential impacts of establishing windfarms or hydrokinetic energy turbines in turtle habitats are relatively unknown (Williams et al., 2015).

4.4.8.4 Impacts of the Proposed Action That May Contribute to Cumulative Impacts

Although susceptible to vessel noise, aircraft noise, and explosives, most activities associated with the Proposed Action would not occur in terrapin or crocodilian habitat and the probability of impacts on these species is anticipated to be extremely low.

The cumulative impacts analysis is generally focused on green, hawksbill, Kemp's Ridley, leatherback, and loggerhead turtles, all of which are ESA-listed species. The analysis presented in Section 3.8 (Reptiles) concludes that some stressors associated with the Proposed Action could impact individuals of certain sea turtle species, but impacts are not expected to decrease the overall fitness of any sea turtle population. From a cumulative perspective, potential impacts on ESA-listed species are of particular concern, and mitigation measures designed to avoid potential impacts are discussed in Chapter 5 (Mitigation).

Impacts from the Proposed Action that may contribute to cumulative impacts on sea turtles can be generally categorized as behavioral responses, TTS, PTS, injury (modeled as slight lung injury), and mortality. As summarized below, these impacts would be associated with certain acoustic and physical strike stressors:

- The use of sonar and transducers may result in behavioral responses, TTS, and PTS in sea turtles (Tables 3.8-6 through 3.8-8) including ESA-listed sea turtles (Table 3.8-1).
- Explosives may result in behavioral responses, TTS, PTS, injury, and mortality in sea turtles (Tables 3.8-7 through 3.8-10), including ESA-listed sea turtles (Table 3.5-1).

- Vessel strikes may cause injury or mortality in sea turtles, including ESA-listed sea turtles (Section 3.5.3.3.1, Impacts from Vessels).

The remaining acoustic stressors (noise from air guns, weapons firing/launch/impact, aircraft overflight, and vessels), energy stressors (electromagnetic and high energy lasers), physical disturbance and strike stressors (in-water devices, military expended materials, and seafloor devices), entanglement stressors (cables, wires, and decelerators/parachutes), ingestion stressors (munitions and military expended materials other than munitions), and secondary stressors are not expected to result in TTS, PTS, injury, or mortality of sea turtles under the Proposed Action, including ESA-listed sea turtles. The Proposed Action would not introduce significant light sources that would disorient nesting turtles or their hatchlings. Because Navy training and testing activities analyzed in this EIS/OEIS do not co-occur with nesting activities, it is unlikely that stressors presented to sea turtles will contribute to other anthropogenic threats not caused by Navy activities.

Although sea turtles could be exposed to sound and energy from explosive detonations throughout the Study Area, the estimated impacts on individual sea turtles are unlikely to affect populations. Injured sea turtles could suffer reduced fitness and long-term survival. Sea turtles that experience TTS or PTS may have reduced ability to detect relevant sounds such as predators or prey, although some experiencing TTS would recover quickly, possibly in a matter of minutes. It is uncertain whether some permanent hearing loss over a part of a sea turtle's hearing range would have long-term consequences for that individual because the sea turtle hearing range is already limited (Section 3.8.3.1, Acoustic Stressors). Any significant behavioral reactions to acoustic stimuli could lead to a sea turtle expending energy and missing opportunities to secure resources. However, most individuals are not likely to experience long-term consequences from behavioral reactions because exposures would be intermittent and spatially distributed, allowing exposed individuals to recover. Since long-term consequences for most individuals are unlikely, long-term consequences for populations are not expected.

The Proposed Action is not anticipated to have any effect on sea turtle nesting beaches or crocodilian or terrapin habitat in the region of influence. The training and testing activities associated with the Proposed Action would not contribute to factors that impact nesting habitats for these species.

In summary and as determined in Section 3.8.4 (Summary of Potential Impacts on Reptiles), it is not anticipated that the Proposed Action would result in significant impacts to reptiles. Due to the wide dispersion of stressors and dynamic movement of many training and testing activities, it is unlikely that a sea turtle would remain in the potential impact range of multiple sources or sequential exercises. Additionally, the majority of the proposed activities are unit level training and small testing activities, which occur over a small spatial scale (one to a few square miles) and with few participants (usually one or two) or short duration (the order of a few hours or less). Likewise, training and testing activities are generally separated in space and time in such a way that it would be unlikely that any individual sea turtle would be exposed to stressors from multiple activities within a short timeframe. Furthermore, research and monitoring efforts have included before, during, and after-event observations and surveys; data collection through conducting long-term studies in areas of Navy activity; occurrence surveys over large geographic areas; biopsy of animals occurring in areas of Navy activity; and tagging studies where animals are exposed to Navy stressors. To date, the findings from the research and monitoring and the regulatory conclusions from previous analyses by NMFS (National Marine Fisheries Service, 2015a; National Oceanic and Atmospheric Administration, 2013) are that the majority of impacts from Navy training and testing activities are not expected to have deleterious impacts on the fitness of any individuals or long-term consequences to populations of sea turtles.

4.4.8.5 Cumulative Impacts on Reptiles

The fact that all five species of sea turtles occurring in the Study Area are ESA-listed provides a clear indication that the current aggregate impacts of past human activities are significant for sea turtles. Bycatch, vessel strikes, coastal land development, and ocean pollution are the leading causes of mortality and population decline for sea turtles, and, although mitigated/avoided to the greatest extent practicable, the Proposed Action could also result in stress, injury, and mortality to individuals of some sea turtle species from underwater explosions and vessel strikes. Implementation of observation and delay measures discussed in Chapter 5.0 (Mitigation) would help avoid, but not absolutely eliminate, the risk for potential impacts, and any incidence of injury and mortality that might occur under the Proposed Action could be additive to injury and mortality associated with other actions in the region of influence.

Due to standard operating procedures and mitigation measures, most impacts associated with the Proposed Action are not anticipated to interact with or increase similar stressors experienced throughout the region of influence. According to scientific studies, reptiles may rely primarily on senses other than hearing for interacting with their environment and appear to quickly recover from noise stressors (Section 3.8.3.1, Acoustic Stressors); thus, the acoustic stressors produced by Navy activities are anticipated to have minimal cumulative impact on sea turtles. The Proposed Action will not affect turtle nesting or crocodilian habitat, and contaminants and debris discharged into the marine environment are expected to be negligible and not persistent (Section 4.4.1.2, Sediment and Water Quality). Affects from the Proposed Action to sea turtle food sources are avoided or insignificant (Section 4.4.1.4, Invertebrates and Section 4.4.1.3, Vegetation). Likewise, Navy actions generally would not overlap in space and time with other stressors as they occur as dispersed, infrequent, and isolated events that do not last for extended periods of time.

The potential exists for the impacts of ocean pollution (disease, malnourishment), injury, nesting habitat loss, starvation, and the composite increased underwater noise environment to contribute multiple stressors to an individual, and it is possible that the response of a previously stressed animal to impacts associated with the Proposed Action could be more severe than the response of an unstressed animal, or that impacts from the Proposed Action could make an individual more susceptible to other stressors. For example, if a Navy vessel were to strike an otherwise healthy sea turtle, exposure to multiple other stressors in the area may hinder the individual's recovery from any injury sustained in the accident. Likewise, a sea turtle in the vicinity of an underwater explosion or sonar activity may become stressed or disoriented, and the time to recover may be increased if that individual is likewise experiencing disease, malnutrition, or other strike injury that may increase its vulnerability to predation or decrease its ability to forage.

In summary, the aggregate impacts of past, present, and other reasonably foreseeable future actions continue to have significant impacts on all reptile species in the Study Area. The Proposed Action could contribute incremental stressors to individuals, which would further compound effects on a given individual already experiencing stress. However, with the implementation of standard operating procedures reducing the likelihood of overlap in time and space with other stressors and the implementation of mitigation measures reducing the likelihood of impacts, the incremental stressors anticipated from the Proposed Action are not anticipated to be significant. Additionally, as with marine mammals, the NMFS regulatory process includes population assessments and 5-year reviews for all ESA-listed species, which provides a backstop that informs decisions on take authorizations and Biological Opinions. Biological Opinions for federal and non-federal actions are grounded in status reviews and conditioned to avoid jeopardy and to allow continued progress toward recovery. This processes helps to ensure that, through compliance with these regulatory requirements, the Navy's Proposed Action would not have a measurable effect on the resource.

4.4.9 Birds and Bats

Although not uniformly distributed, the region of influence for birds includes shorelines, surface water, water column and shallow bottom habitats, and airspace throughout the Study Area. Bats are also present in marine environments, although they do not utilize water column and shallow bottom habitat. The majority of species encountered in the Study Area are waterbirds, including seabirds, wading birds, shorebirds, and waterfowl that use Study Area habitat for breeding, foraging, roosting, and migration. The remainder of species that may be regularly encountered in the Study Area are landbirds that are coastal resident species that live on land but forage in the adjacent coastal and inshore waters or neotropical migrant species (primarily songbirds) that occur briefly during transit between breeding areas in eastern North America and wintering areas in Central and South America and the Caribbean. Many bat species occur in coastal (nearshore) waters, offshore waters (continental shelf), or open ocean areas while migrating or foraging. Bats almost exclusively use echolocation to navigate and feed, and they will use islands, ships, and other offshore structures as opportunistic or deliberate stopover sites for resting or roosting.

All projects in the Study Area that affect ESA-listed species, species protected under the Migratory Bird Treaty Act, and U.S. Fish and Wildlife Service Birds of Conservation Concern are subject to regulatory processes and permitting that gives agencies a landscape management perspective of population trends and conservation measures. ESA-listed species are described in Table 3.9-1; there are four species of birds and two species of bats listed as endangered or threatened and one bird species with designated critical habitat under the ESA that occur in the Study Area. Despite numerous protective laws and regulations, seabirds are some of the most threatened marine animals in the world, with 29 percent of species at risk of extinction and approximately half of the 346 species of seabirds that depend on ocean habitats in decline (Section 3.9.2.1.5, General Threats). Bat populations are also in precipitous decline, impacted chiefly by disease (Section 3.9.2.1.5.3, Disease and Parasites).

Birds and bats are susceptible to multiple stressors, and the susceptibility of many species could be enhanced by additive or synergistic effects of multiple stressors. Section 3.9.2.1.5 (General Threats) includes an extensive discussion of the existing stressors to bird and bat populations in the Study Area, and all activities listed in Table 4.2-1 and stressors described in Table 4.2-2 contribute one or more of these stressors. Other activities in the Study Area that could have direct impacts on birds and bats include wind energy development (strike mortality and forage displacement); noise, light, and water pollution (direct impacts from major spills, indirect impacts from habitat loss and degradation, and marine debris); commercial fishing (loss of food source, strike, and entanglement); climate change; coastal land development (disturbance, collisions, and loss of breeding, nesting, or foraging habitat); and operation of ports and terminals or military training areas (disturbance). Commercial fisheries are considered the most serious threat to the world's seabirds. Most of the birds in the Study Area are relatively long-lived and wide-ranging seabirds, making it likely that individuals would be exposed to multiple activities and stressors over the course of their lifespans.

The analysis in Section 3.9 (Birds and Bats) indicates that birds and bats (to a lesser extent) could potentially be impacted by in air and underwater acoustic stressors (sonar and other transducers, pile driving, air guns, weapons firing, aircraft and vessel noise), explosives (shock wave, sound, fragments), energy stressors (electromagnetic devices, lasers), physical disturbance and strikes (aircraft, aerial targets, vessels and in-water devices, military expended materials, seafloor devices, pile driving), entanglement (fiber optic cables, guidance wires, vessel entanglement systems, and decelerators/parachutes), ingestion (military expended materials), and secondary stressors (explosives and explosion byproducts, unexploded munition, metals, chemicals, other materials, physical disturbance). Some stressors, including explosions, physical strikes, and ingestion of plastic military expended materials, could result in mortality. In general, however, the potential for training and testing activities to result in the injury or mortality of birds or bats is considered low to discountable, depending on the specific training or testing activity being considered. The vast majority of impacts are expected to be nonlethal: the most likely responses to training and testing activities are short-term behavioral or physiological, such as alert response, startle response, cessation of feeding, fleeing the immediate area, and a temporary increase in heart rate. Recovery from the impacts of most stressor exposures that elicit such short-term behavioral or physiological responses would occur quickly.

Impacts that elicit behavioral or physiological impacts can combine with other stressors experienced elsewhere and result in decreased fitness of the individual as it moves throughout the Study Area. However, most of the proposed activities would be widely dispersed in offshore areas where bats are infrequent, bird distribution is patchy, and concentrations of individuals are often low; therefore, the potential for interactions between bats, birds and training and testing activities is low. Likewise, for most stressors associated with the Proposed Action, impacts would be short term and localized, and physiological recovery would occur quickly for any individuals experiencing a stress response. It is unlikely that training and testing activities would influence nesting because most activities take place in water and away from nesting habitats on land.

Although other past, present, and reasonably foreseeable actions individually and collectively cause widespread disturbance and mortality of bird and bat populations across the ocean landscape, the Proposed Action is not expected to substantially contribute to their diminishing abundance, induce widespread behavioral or physiological stress, or interfere with recovery from other stressors. It is anticipated that the incremental contribution of the Proposed Action, when added to the impacts of all other past, present and reasonably foreseeable future actions, would not result in measurable additional impacts on birds and bats in the Study Area or beyond.

4.4.10 Cultural Resources

As discussed in Section 3.10 (Cultural Resources), stressors, including explosive and physical disturbance and strike stressors associated with the Proposed Action would not affect submerged prehistoric sites and submerged historic resources in accordance with Section 106 of the National Historic Preservation Act because mitigation measures have been implemented to protect and avoid these resources (Chapter 5, Mitigation). Furthermore, consultation with the appropriate State Historic Preservation Office will continue, as needed, for cultural resources located within state territorial waters (within 3 NM of the shoreline, except Texas, Puerto Rico, and Florida [Gulf Coast only], which have a 9 NM limit). The Proposed Action is not expected to result in impacts on cultural resources in the Study Area and likewise would not contribute incrementally to cumulative impacts on cultural resources. Therefore, further analysis of cumulative impacts on cultural resources is not warranted.

4.4.11 Socioeconomics

The analysis in Section 3.11 (Socioeconomics) indicates that the Proposed Action is not expected to result in long-term impacts to socioeconomic resources in the Study Area, including energy production and distribution, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, aquaculture, and tourism. Temporary and short duration (hours) impacts may occur from limits on accessibility to marine areas used by the public (e.g., for fishing and tourism); however, most limitations on accessibility are temporary and would be lifted upon completion of training and testing activities. The public may intermittently hear airborne noise from transiting ships or aircraft overflights if they are in the general vicinity of a training or testing activity. These occurrences would be of short duration and infrequent, and other than transiting vessels and aircraft, most Navy training and testing that generates airborne noise would occur farther from shore than most recreational and tourism activities. Similarly, impacts on socioeconomic resources from physical disturbances and strikes are unlikely given that most training and testing activities that pose a risk of a physical disturbance or strike (e.g., activities using ordnance or military expended materials) occur farther from shore than most fishing or tourism activities. In locations where Navy training or testing occurs in nearshore areas (e.g., pierside), the Navy coordinates with civilian organizations to assure safe and unimpeded access and use of those areas. The Navy's standard operating procedures also require that an area is clear of non-participating vessels and aircraft before an activity using ordnance or expended materials occurs.

Secondary or indirect cumulative impacts on socioeconomic resources are dependent on the availability of other marine resources (e.g., fish species targeted by recreational and commercial fishers). Population-level impacts on fishes, marine mammals, and invertebrates, which are the primary resources indirectly affecting socioeconomics in the Study Area, are not anticipated. No cumulative impacts on commercial transportation and shipping are anticipated because commercial vessels and aircraft are primarily transiting through the Study Area along well established navigable routes or air traffic corridors that are avoided by Navy vessels and aircraft conducting training and testing activities.

Temporary limitations on accessibility to marine areas and the infrequent exposure to airborne noise would not result in a direct loss of income, revenue, employment, resource availability, or quality of experience. Similarly, physical disturbance and strike stressors would have negligible impacts on energy production and distribution, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, aquaculture, and tourism in the Study Area and would not result in direct loss of income, revenue, employment, resource availability, or quality of experience. Short-term impacts, should they occur, would not contribute incrementally to cumulative impacts on socioeconomic resources in the study area. Therefore, further analysis of cumulative impacts on socioeconomic resources is not warranted.

4.4.12 Public Health and Safety

All Proposed Actions would be accomplished by technically qualified personnel and would be conducted in accordance with applicable Navy, state, and federal safety standards and requirements. The analysis presented in Section 3.12 (Public Health and Safety) indicates that the Proposed Action is not expected to result in impacts on public health and safety and likewise would not contribute incrementally to or combine with other impacts on health and safety within the Study Area. Therefore, further analysis of cumulative impacts on public health and safety is not warranted.

4.5 Summary of Cumulative Impacts

The Action Alternatives would contribute incremental effects on the ocean ecosystem, which is already experiencing and absorbing a multitude of stressors to a variety of receptors. In general, it is not anticipated that the implementation of the Proposed Action would have meaningful contribution to the ongoing stress or cause significant collapse of any particular marine resource, but it would further cause minute impacts on resources that are already experiencing various degrees of interference and degradation. It is intended that the mitigation measures described in Chapter 5 (Mitigation) will further reduce the potential impacts of the Proposed Action in such a way that they are avoided to the maximum extent practicable and to ensure that impacts do not become cumulatively significant to any marine resource.

Marine mammals and sea turtles are the primary resources of concern for cumulative impacts analysis, however, the incremental contributions of the Proposed Action are not anticipated to meaningfully contribute to the decline of these populations or interfere with the recovery efforts thereof due to the implementation of standard operating procedures that reduce the likelihood of overlap in time and space and mitigation measures as described in Chapter 5 (Mitigation) that reduce the likelihood of impacts to both resources.

The aggregate impacts of past, present, and other reasonably foreseeable future actions (Table 4.2-1 and Table 4.2-2) have resulted in significant impacts on some marine mammal and all sea turtle species in the Study Area; however, the decline of these species is chiefly attributable to other stressors in the environment, including the synergistic effect of bycatch, entanglement, vessel traffic, ocean pollution, and coastal zone development. The analysis presented in this Chapter 4 (Cumulative Impacts) and Chapter 3 (Affected Environment and Environmental Consequences) indicate that the incremental contribution of the Proposed Action to cumulative impacts on air quality, sediments and water quality, vegetation, invertebrates, marine habitats, fishes, birds and bats, cultural and socioeconomic resources, and public health and safety would not significantly contribute to cumulative stress on those resources.

This page intentionally left blank.

References

American Wind Wildlife Institute. (2017). *Wind Turbine Interactions with Wildlife and Their Habitats*. Washington, DC: American Wind Wildlife Institute.

Anderson, D. M., P. M. Glibert, and J. M. Burkholder. (2002). Harmful algal blooms and eutrophication: Nutrient sources, composition, and consequences. *Estuaries, 25*(4, Part B), 704–726.

Avens, L. (2003). Use of multiple orientation cues by juvenile loggerhead sea turtles *Caretta caretta*. *The Journal of Experimental Biology, 206*(23), 4317–4325.

Bartol, S. M., and J. A. Musick. (2003). Sensory Biology of Sea Turtles. In P. L. Lutz, J. A. Musick, & J. Wyneken (Eds.), *The Biology of Sea Turtles* (Vol. 2, pp. 16). Boca Raton, FL: CRC Press Books.

Bartol, S. M., and D. R. Ketten. (2006). *Turtle and Tuna Hearing* (NOAA Technical Memorandum NMFS-PIFSC-7). Honolulu, HI: Pacific Islands Fisheries Science Center.

Bassett, C., J. Thomson, and B. Polagye. (2010). *Characteristics of Underwater Ambient Noise at a Proposed Tidal Energy Site in Puget Sound*. Seattle, WA: Northwest National Marine Renewable Energy Center.

Baulch, S., and C. Perry. (2014). Evaluating the impacts of marine debris on cetaceans. *Marine Pollution Bulletin, 80*(1–2), 210–221.

Baumann-Pickering, S., L. K. Baldwin, A. E. Simonis, M. A. Roche, M. L. Melcon, J. A. Hildebrand, E. M. Oleson, R. W. Baird, G. S. Schorr, D. L. Webster, and D. J. McSweeney. (2010). *Characterization of Marine Mammal Recordings from the Hawaii Range Complex*. Monterey, CA: Naval Postgraduate School.

Bergmann, M., L. Gutow, and M. Klages. (2015). *Marine Anthropogenic Litter*. New York, NY and London, United Kingdom: Springer.

Bergström, L., L. Kautsky, T. Malm, R. Rosenberg, M. Wahlberg, N. Åstrand Capetillo, and D. Wilhelmsson. (2014). Effects of offshore wind farms on marine wildlife–A generalized impact assessment. *Environmental Research Letters, 9*(3), 12.

Bureau of Ocean Energy Management, and Regulation and Enforcement. (2011). *BOEMRE approves first-ever use of deepwater floating production storage offloading facility in Gulf of Mexico*. Retrieved from http://www.boemre.gov/ooc/press/2011/press0317.htm.

Bureau of Ocean Energy Management. (2012). *Final Environmental Assessment for Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia*. Washington, DC: Office of Renewable Energy Programs.

Bureau of Ocean Energy Management. (2013a). *Review of Biological and Biophysical Impacts from Dredging and Handling of Offshore Sand*. Herndon, VA: U.S. Department of the Interior, Bureau of Ocean Energy Management.

Bureau of Ocean Energy Management. (2013b). *Revised Environmental Assessment for Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Rhode Island and Massachusetts*. Washington, DC: Office of Renewable Energy Programs.

Bureau of Ocean Energy Management. (2014a). *Record of Decision for Final Programmatic Environmental Impact Statement for Atlantic OCS Proposed Geological and Geophysical Activities Mid-Atlantic and South Atlantic Planning Areas*. New Orleans, LA: U.S. Department of the Interior.

Bureau of Ocean Energy Management. (2014b). *Final Programmatic Environmental Impact Statement for Atlantic OCS Proposed Geological and Geophysical Activities Mid-Atlantic and South Atlantic Planning Areas*. New Orleans, LA: U.S. Department of the Interior.

Bureau of Ocean Energy Management. (2015a). *Marine Mineral Projects*. Retrieved from http://www.boem.gov/Marine-Mineral-Projects/.

Bureau of Ocean Energy Management. (2015b). *2017–2022 Outer Continental Shelf Oil and Gas Leasing Draft Proposed Program*. Washington, DC: U.S. Department of the Interior, Bureau of Ocean Energy Management.

Bureau of Ocean Energy Management. (2016a). *Fact Sheet: Marine Minerals Program Research and Studies*. Washington, DC: U.S. Department of the Interior. Retrieved from https://www.boem.gov/Marine-Minerals-Program/.

Bureau of Ocean Energy Management. (2016b). *Fact Sheet: Environmental Studies–Electromagnetic Fields*. Sterling, VA: U.S. Department of the Interior, Bureau of Ocean Energy Management. Retrieved from www.boem.gov.

Bureau of Ocean Energy Management. (2016c). *Final Programmatic Environmental Impact Statement for the Outer Continental Shelf Oil and Gas Leasing Program: 2017–2022*. Sterling, VA: U.S. Department of the Interior, Bureau of Ocean Energy Management.

Bureau of Ocean Energy Management. (2016d). *2017–2022 Outer Continental Shelf Oil and Gas Leasing Proposed Final Program*. Sterling, VA: U.S. Department of the Interior, Bureau of Ocean Energy Management.

Bureau of Ocean Energy Management. (2017a). *Fact Sheet: Marine Minerals Program*. Washington, DC: U.S. Department of the Interior. Retrieved from http://www.boem.gov/Marine-Minerals-Program/.

Bureau of Ocean Energy Management. (2017b). *Fact Sheet: Renewable Energy on the Outer Continental Shelf*. Washington, DC: U.S. Department of the Interior. Retrieved from www.boem.gov.

Bureau of Ocean Energy Management. (2017c). *Office of Environment*. Retrieved from https://www.boem.gov/Office-of-Environment/.

Bureau of Ocean Energy Management. (2017d). *Combined Leasing Report as of March 1, 2017*. New Orleans, LA: U.S. Department of the Interior, Bureau of Ocean Energy Management.

Bureau of Ocean Energy Management. (2017e). *Record of Decision and Approval of the 2017–2022 Outer Continental Shelf Oil and Gas Leasing Program*. Washington, DC: U.S. Department of the Interior.

Bureau of Safety and Environmental Enforcement. (2015). *Public Information Query Results for G&G*. Retrieved from http://data.bsee.gov/homepg/data_center/other/WebStore/pilist.asp?appid=5.

Bureau of Safety and Environmental Enforcement. (2017a). *Gulf of Mexico Fact Sheet*. Retrieved from https://www.bsee.gov/stats-facts/ocs-regions/gulf-of-mexico.

Bureau of Safety and Environmental Enforcement. (2017b). *Offshore Incident Statistics*. Retrieved from https://www.bsee.gov/stats-facts/offshore-incident-statistics.

Bureau of Safety and Environmental Enforcement. (2017c). *Offshore Statistics by Water Depth*. Retrieved from https://www.data.boem.gov/Leasing/OffshoreStatsbyWD/Default.aspx.

Celi, M., F. Filiciotto, M. Vazzana, V. Arizza, V. Maccarrone, M. Ceraulo, S. Mazzola, and G. Buscaino. (2015). Shipping noise affecting immune responses of European spiny lobster (*Palinurus elephas*). *Canadian Journal of Zoology, 93*, 113–121.

Chaloupka, M., T. M. Work, G. H. Balazs, S. K. K. Murakawa, and R. Morris. (2008). Cause-specific temporal and spatial trends in green sea turtle strandings in the Hawaiian Archipelago (1982–2003). *Marine Biology, 154*, 887–898.

Corcoran, A., M. Dornback, B. Kirkpatrick, and A. Jochens. (2013). *A Primer on Gulf of Mexico Harmful Algal Blooms*. College Station, TX: Gulf of Mexico Alliance and the Gulf of Mexico Coastal Ocean Observing System.

Council on Environmental Quality. (1997). *Considering Cumulative Effects Under the National Environmental Policy Act*. Washington, DC: The Council on Environmental Quality.

Deaton, C., C. Hein, and M. Kirwan. (2017). *Barrier island migration dominates ecogeomorphic feedbacks and drives salt marsh loss along the Virginia Atlantic Coast, USA* (GSA Data Repository 2017030). Boulder, CO: The Geological Society of America, Inc.

Deepwater Horizon Natural Resource Damage Assessment Trustees. (2016). *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement*. Silver Spring, MD: National Oceanic and Atmospheric Administration.

DeMaster, D. P., C. W. Fowler, S. L. Perry, and M. F. Richlen. (2001). Predation and competition: The impact of fisheries on marine-mammal populations over the next one hundred years. *Journal of Mammalogy, 82*(3), 641–651.

Denkinger, J., M. Parra, J. P. Muñoz, C. Carrasco, J. C. Murillo, E. Espinosa, F. Rubianes, and V. Koch. (2013). Are boat strikes a threat to sea turtles in the Galapagos Marine Reserve? *Ocean & Coastal Management, 80*, 29–35.

Edmonds, N. J., C. J. Firmin, D. Goldsmith, R. C. Faulkner, and D. T. Wood. (2016). A review of crustacean sensitivity to high amplitude underwater noise: Data needs for effective risk assessment in relation to UK commercial species. *Marine Pollution Bulletin, 108*, 5–11.

Edwards, H. H. (2013). Potential impacts of climate change on warmwater megafauna: The Florida manatee example (*Trichechus manatus latirostris*). *Climatic Change, 121*(4), 727–738.

Eglin Air Force Base. (2015). *Final Environmental Assessment for the Eglin Gulf Test and Training Range*. Eglin Air Force Base, FL: U.S. Air Force, Eglin Air Force Base.

Eschmeyer, W. N., and J. D. Fong. (2017). *Catalog of Fishes*. San Francisco, CA: California Academy of Sciences. Retrieved from http://researcharchive.calacademy.org/research/ichthyology/catalog/SpeciesByFamily.asp.

Fechter, L. D., and B. Pouyatos. (2005). Ototoxicity. *Environmental Health Perspectives, 113*(7), 443–444.

Federal Communications Commission. (2017). *Submarine Cables*. Retrieved from https://www.fcc.gov/submarine-cables.

Federal Energy Regulatory Commission. (2017a). *North American Liquefied Natural Gas Import/Export Terminals: Existing*. Washington, DC: Federal Energy Regulatory Commission. Retrieved from https://www.ferc.gov/industries/gas/indus-act/lng/lng-existing.pdf.

Federal Energy Regulatory Commission. (2017b). *North American Liquefied Natural Gas Import Terminals: Proposed*. Washington, DC: Federal Energy Regulatory Commission. Retrieved from https://www.ferc.gov/industries/gas/indus-act/lng/lng-proposed-import.pdf.

Federal Energy Regulatory Commission. (2017c). *North American Liquefied Natural Gas Export Terminals: Proposed*. Washington, DC: Federal Energy Regulatory Commission. Retrieved from https://www.ferc.gov/industries/gas/indus-act/lng/lng-proposed-export.pdf.

Federal Energy Regulatory Commission. (2017d). *North American Liquefied Natural Gas Import/Export Terminals: Approved*. Washington, DC: Federal Energy Regulatory Commission. Retrieved from https://www.ferc.gov/industries/gas/indus-act/lng/lng-approved.pdf.

Flewelling, L. J., J. P. Naar, J. Abbott, D. Baden, N. Barros, G. Bossart, M.-Y. Bottein, D. Hammond, E. Haubold, C. Heil, M. Henry, H. Jacocks, T. Leighfield, R. Pierce, T. Pitchford, R. Sentiel, P. Scott, K. Steidinger, E. Truby, F. Van Dolah, and J. Landsberg. (2005). Red tides and marine mammal mortalities: Unexpected brevetoxin vectors may account for deaths long after or remote from an algal bloom. *Nature, 435*(7043), 755–756.

Geijer, C. K. A., and A. J. Read. (2013). Mitigation of marine mammal bycatch in U.S. fisheries since 1994. *Biological Conservation, 159*, 54–60.

Gerstein, E. R. (2002). Manatees, bioacoustics and boats: Hearing tests, environmental measurements and acoustic phenomena may together explain why boats and animals collide. *American Scientist, 90*(2), 154–163.

Hamer, D. J., S. J. Childerhouse, and N. J. Gales. (2010). *Mitigating Operational Interactions Between Odontocetes and the Longline Fishing Industry: A Preliminary Global Review of the Problem and of Potential Solutions*. Tasmania, Australia: International Whaling Commission.

Hansen, L. P., and M. L. Windsor. (2006). Interactions between aquaculture and wild stocks of Atlantic salmon and other diadromous fish species: Science and management, challenges and solutions. *ICES Journal of Marine Science, 63*(7), 1159–1161.

Hardesty, B. D., and C. Wilcox. (2017). A risk framework for tackling marine debris. *Royal Society of Chemistry, 9*, 1429–1436.

Hazel, J., I. R. Lawler, H. Marsh, and S. Robson. (2007). Vessel speed increases collision risk for the green turtle *Chelonia mydas*. *Endangered Species Research, 3*, 105–113.

Henry, A. G., T. V. N. Cole, L. Hall, W. Ledwell, D. Morin, and A. Reid. (2016). *Serious Injury and Mortality Determinations for Baleen Whale Stocks along the Gulf of Mexico, United States East Coast and Atlantic Canadian Provinces, 2010–2014*. Woods Hole, MA: U.S. Department of Commerce.

Humber, F., B. J. Godley, and A. C. Broderick. (2014). So excellent a fishe: A global overview of legal marine turtle fisheries. *Diversity and Distributions, 20*(5), 579–590.

International Council for the Exploration of the Sea. (2005). *Report of the Ad-hoc Group on the Impacts of Sonar on Cetaceans and Fish (AGISC)*. Copenhagen, Denmark: International Council for the Exploration of the Sea.

Jackson, J. B. C., M. X. Kirby, W. H. Berger, K. A. Bjorndal, L. W. Botsford, B. J. Bourque, R. H. Bradbury, R. Cooke, J. M. Erlandson, J. A. Estes, T. P. Hughes, S. Kidwell, C. B. Lange, H. S. Lenihan, J. M.

Pandolfi, C. H. Peterson, R. S. Steneck, M. J. Tegner, and R. R. Warner. (2001). Historical overfishing and the recent collapse of coastal ecosystems. *Science, 293*, 629–638.

Kappel, C. V. (2005). Losing pieces of the puzzle: Threats to marine, estuarine, and diadromous species. *Frontiers in Ecology and the Environment, 3*(5), 275–282.

Ketten, D. R., and S. Moein-Bartol. (2006). *Functional Measures of Sea Turtle Hearing*. Woods Hole, MA: Woods Hole Oceanographic Institution.

Knowlton, A. R., P. K. Hamilton, M. K. Marx, H. M. Pettis, and S. D. Kraus. (2012). Monitoring North Atlantic right whale *Eubalaena glacialis* entanglement rates: A 30 year retrospective. *Marine Ecology Progress Series, 466*, 293–302.

Laist, D. W., A. R. Knowlton, J. G. Mead, A. S. Collet, and M. Podesta. (2001). Collisions between ships and whales. *Marine Mammal Science, 17*(1), 35–75.

Laist, D. W., and C. Shaw. (2006). Preliminary evidence that boat speed restrictions reduce deaths of Florida manatees. *Marine Mammal Science, 22*(2), 472–479.

Lam, T., Lingxu, S. Takahashi, and E. A. Burgess. (2011). *Market Forces: An Examination of Marine Turtle Trade in China and Japan*. Hong Kong, China: TRAFFIC East Asia.

Levenson, D. H., S. A. Eckert, M. A. Crognale, J. F. Deegan, II, and G. H. Jacobs. (2004). Photopic spectral sensitivity of green and loggerhead sea turtles. *Copeia, 4*, 908–914.

Levinton, J. S. (2009). Seaweeds, sea grasses, and benthic microorganisms. In *Marine Biology: Function, Biodiversity, Ecology* (3rd ed., pp. 309–320). New York, NY: Oxford University Press.

Lohmann, K. J., and C. M. F. Lohmann. (1992). Orientation to oceanic waves by green turtle hatchlings. *The Journal of Experimental Biology, 171*, 1–13.

Lohmann, K. J., and C. M. F. Lohmann. (1996). Orientation and open-sea navigation in sea turtles. *The Journal of Experimental Biology, 199*, 73–81.

Lutcavage, M. E., P. Plotkin, B. Witherington, and P. L. Lutz. (1997). Human impacts on sea turtle survival. In P. L. Lutz & J. A. Musick (Eds.), *The Biology of Sea Turtles* (pp. 387–409). New York, NY: CRC Press.

Maison, K. A., I. K. Kelly, and K. P. Frutchey. (2010). *Green Turtle Nesting Sites and Sea Turtle Legislation throughout Oceania* (National Oceanic and Atmospheric Administration Technical Memorandum NMFS-F/SPO-110). Silver Spring, MD: Scientific Publications Office.

Mazaris, A., G. Schofield, C. Gkazinou, V. Almpanidou, and G. Hays. (2017). Global sea turtle conservation successes. *Science Advances, 3*(9), 1–7.

Mazzotti, F. J., L. A. Brandt, P. Moler, and M. S. Cherkiss. (2007). American crocodile (*Crocodylus acutus*) in Florida: Recommendations for endangered species recovery and ecosystem restoration. *Journal of Herpetology, 41*(1), 122–132.

McDonald, M. A., J. A. Hildebrand, and S. M. Wiggins. (2006). Increases in deep ocean ambient noise in the Northeast Pacific west of San Nicolas Island, California. *The Journal of the Acoustical Society of America, 120*(2), 711–718.

Minerals Management Service. (2001). Record of Decision for the Environmental Impact Statement on the Proposed Use of Floating Production, Storage, and Offloading Systems on the Gulf of Mexico Outer Continental Shelf, Western and Central Planning Areas. *Federal Register, 66*(250), 67542–67543.

Minerals Management Service. (2005). *Structure-Removal Operations on the Gulf of Mexico Outer Continental Shelf: Programmatic Environmental Assessment*. New Orleans, LA: Gulf of Mexico OCS Region.

Minerals Management Service. (2007). *Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf: Final Environmental Impact Statement*. New Orleans, LA: Gulf of Mexico OCS Region.

Mintz, J. D. (2012). *Vessel Traffic in the Hawaii-Southern California and Atlantic Fleet Testing and Training Study Areas*. (CRM D0026186.A2/Final). Alexandria, VA: Center for Naval Analyses.

Moore, S. K., V. L. Trainer, N. J. Mantua, M. S. Parker, E. A. Laws, L. C. Backer, and L. E. Fleming. (2008). Impacts of climate variability and future climate change on harmful algal blooms and human health. *Environmental Health, 7*(Supplement 2), S4.

Moyle, P. B., and J. J. Cech, Jr. (2004). *Fishes: An Introduction to Ichthyology* (5th ed.). London, United Kingdom: Pearson Educational, Inc.

Mrosovsky, N., G. D. Ryan, and M. C. James. (2009). Leatherback turtles: The menace of plastic. *Marine Pollution Bulletin, 58*(2), 287–289.

Myers, R. A., and B. Worm. (2003). Rapid worldwide depletion of predatory fish communities. *Nature, 423*, 280–283.

National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. (2011). *Deepwater: The Gulf Oil Disaster and the Future of Offshore Drilling*. Washington, DC. Retrieved from http://www.oilspillcommission.gov/final-report.

National Marine Fisheries Service. (2006). *Marine Debris: Impacts in the Gulf of Mexico*. Lafayette, LA: Southeast Regional Office, Protected Resources Division.

National Marine Fisheries Service. (2009a). *Endangered Species Act Section 7 Consultation: Biological Opinion for U.S. Navy Activities in the Northeast, Virginia Capes, Cherry Point, and Jacksonville*. Washington, DC: United States Department of Commerce, National Oceanic and Atmospheric Administration and National Marine Fisheries Service.

National Marine Fisheries Service. (2009b). *Endangered Species Act Section 7 Consultation: Final Biological Opinion, Hawaii Range Complex*. Washington, DC: United States Navy and National Marine Fisheries Service.

National Marine Fisheries Service. (2011a). *Large whale incident database: Unpublished data 1995–2011*. Retrieved from https://data.noaa.gov/dataset/large-whale-incident-database.

National Marine Fisheries Service. (2011b). *Effects of Oil and Gas Activities in the Arctic Ocean Draft Environmental Impact Statement*. Silver Spring, MD: U.S. Department of Commerce and National Oceanic and Atmospheric Administration.

National Marine Fisheries Service. (2014a). *Deepwater Horizon Oil Spill 2010: Sea Turtles, Dolphins, and Whales*. Retrieved from https://www.fisheries.noaa.gov/national/marine-life-distress/deepwater-horizon-oil-spill-2010-sea-turtles-dolphins-and-whales.

National Marine Fisheries Service. (2014b). *Biological Opinion: Reinitiation of Endangered Species Act (ESA) Section 7 Consultation on the Continued Implementation of the Sea Turtle Conservation Regulations under the ESA and the Continued Authorization of the Southeast U.S. Shrimp Fisheries in Federal Waters under the Magnuson-Stevens Fishery Management and Conservation*

Act. Washington, DC: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

National Marine Fisheries Service. (2015a). *Reinitiated Biological Opinion and Conference Report on U.S. Navy Hawaii-Southern California Training and Testing*. Washington, DC: The United States Navy and National Oceanic and Atmospheric Administration's National Marine Fisheries Service, Office of Protected Resources' Permits and Conservation Division.

National Marine Fisheries Service. (2015b). *Status Review of the Humpback Whale (Megaptera novaeangliae) Under the Endangered Species Act* (NOAA Technical Memorandum NMFS-SWFSC-540). La Jolla, CA: Southwest Fisheries Science Center.

National Marine Fisheries Service. (2015c). *Fisheries of the United States 2014*. (NOAA Current Fishery Statistics No. 2014). Retrieved from https://www.st.nmfs.noaa.gov/commercial-fisheries/fus/fus14/index.

National Marine Fisheries Service. (2015d). *Marine Aquaculture Strategic Plan FY 2016–2020*. Silver Spring, MD: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

National Marine Fisheries Service. (2016a). *U.S. National Bycatch Report First Edition Update 2*. Silver Spring, MD: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Retrieved from http://www.st.nmfs.noaa.gov/observer-home/first-edition-update-2.

National Marine Fisheries Service. (2016b). *Fisheries Economics of the United States, 2014*. Silver Spring, MD: U.S. Department of Commerce, NOAA Technical Memorandum National Marine Fisheries Service-F/SPO-163.

National Marine Fisheries Service. (2017). *Frequent Questions – 2017 North Atlantic Right Whale Unusual Mortality Event*. Retrieved from https://www.fisheries.noaa.gov/insight/frequent-questions-2017-north-atlantic-right-whale-unusual-mortality-event.

National Marine Fisheries Service. (2018a). *2010-2014 Cetacean Unusual Mortality Event in Northern Gulf of Mexico*. Retrieved from https://www.fisheries.noaa.gov/national/marine-life-distress/2010-2014-cetacean-unusual-mortality-event-northern-gulf-mexico.

National Marine Fisheries Service. (2018b). *Letter of Authorization for Training and Testing Activities Conducted in the Eglin Gulf Testing and Training Range*. Silver Spring, MD: National Marine Fisheries Service.

National Oceanic and Atmospheric Administration. (2013). Takes of Marine Mammals Incidental to Specified Activities; U.S. Navy Training and Testing Activities in the Hawaii-Southern California Training and Testing Study Area; Final Rule. *Federal Register, 78*(247), 78106–78158.

National Oceanic and Atmospheric Administration. (2016). *Average 'Dead Zone' for Gulf of Mexico Predicted*. Silver Spring, MD: U.S. Department of Commerce, National Oceanic and Atmospheric Administration. Retrieved from http://www.noaa.gov/media-release/average-dead-zone-for-gulf-of-mexico-predicted.

National Oceanic and Atmospheric Administration. (2017a). *Sea Turtle Stranding and Salvage Network*. Retrieved from https://www.sefsc.noaa.gov/species/turtles/strandings.htm.

National Oceanic and Atmospheric Administration. (2017b). *National Oceanic and Atmospheric Administration Studies Documenting the Impacts of the Deepwater Horizon Oil Spill*. Retrieved from https://response.restoration.noaa.gov/deepwater-horizon-oil-spill/noaa-studies-documenting-impacts-deepwater-horizon-oil-spill.html.

National Oceanic and Atmospheric Administration. (2017c). *Coral Bleaching and Disease*. Retrieved from https://www.pifsc.noaa.gov/cred/coral_bleaching_and_disease.php.

National Oceanic and Atmospheric Administration. (2017d). *What are HABs*. Retrieved from https://habsos.noaa.gov/about/.

National Oceanic and Atmospheric Administration. (2018a). *Programmatic Enviornmental Assessment of Field Operations in the Northeast and Great Lakes National Marine Sanctuaries*. Silver Spring, MD: Office of National Marine Sanctuaries.

National Oceanic and Atmospheric Administration. (2018b). *Programmatic Environmental Assessment of Field Operations in the Southeast and Gulf of Mexico*. Silver Spring, MD: National Oceanic and Atmospheric AdministrationOffice of National Marine Sanctuaries.

National Research Council of the National Academies. (1990). *Decline of the sea turtles: Causes and prevention*. Washington, DC: The National Academies Press.

Northridge, S. (2008). Fishing industry, effects of. In W. F. Perrin, B. Wursig, & J. G. M. Thewissen (Eds.), *Encyclopedia of Marine Mammals* (2nd ed., pp. 443–447). Cambridge, MA: Academic Press.

Nowacek, D., M. Johnson, and P. Tyack. (2004). North Atlantic right whales (*Eubalaena glacialis*) ignore ships but respond to alerting stimuli. *Proceedings of the Royal Society of London, 271*(B), 227–231.

O'Shea, T. J., R. R. Reeves, and A. K. Long. (1999). *Marine Mammals and Persistent Ocean Contaminants.* Paper presented at the Marine Mammal Commission Workshop October 12–15 1998, Keystone, CO.

Ormerod, S. J. (2003). Current issues with fish and fisheries: Editor's overview and introduction. *Journal of Applied Ecology, 40*(2), 204–213.

Oros, J., A. Torrent, P. Calabuig, and S. Deniz. (2005). Diseases and causes of mortality among sea turtles stranded in the Canary Islands, Spain (1998–2001). *Diseases of Aquatic Organisms, 63*, 13–24.

Ortmann, A. C., J. Anders, N. Shelton, L. Gong, A. G. Moss, and R. H. Condon. (2012). Dispersed oil disrupts microbial pathways in pelagic food webs. *PLoS ONE, 7*(7), e42548.

Poloczanska, E. S., M. T. Burrows, C. J. Brown, J. G. Molinos, B. S. Halpern, O. Hoegh-Guldberg, C. V. Kappel, P. J. Moore, A. J. Richardson, D. S. Schoeman, and W. J. Sydeman. (2016). Responses of marine organisms to climate change across oceans. *Frontiers in Marine Science, 3*(62), 1–21.

Read, A., P. Drinker, and S. Northridge. (2006). Bycatch of marine mammals in U.S. and global fisheries. *Conservation Biology, 20*(1), 163–169.

Read, A. J. (2008). The looming crisis: Interactions between marine mammals and fisheries. *Journal of Mammalogy, 89*(3), 541–548.

Reinert, T., A. Spellman, M. deWit, and B. Basset. (2011). *Impacts of Fishing Gear and other Marine Debris on Florida Manatees*. Paper presented at the 19th Biennial Conference for the Society of Marine Mammalogy. Tampa, FL. Retrieved from: http://www.marinemammalscience.org/smmtampa/Reinert_Thomas_57-2.pdf.

Roberts, L., S. Cheesman, M. Elliott, and T. Breithaupt. (2016). Sensitivity of *Pagurus bernhardus* (L.) to substrate-borne vibration and anthropogenic noise. *Journal of Experimental Marine Biology and Ecology, 474*, 185–194.

Roman, J., I. Altman, M. M. Dunphy-Daly, C. Campbell, M. Jasny, and A. J. Read. (2013). The Marine Mammal Protection Act at 40: Status, Recovery, and Future of U.S. Marine Mammals. *Annals of the New York Academy of Sciences, 1286*, 29–49.

Rommel, S., A. M. Costidis, T. D. Pitchford, J. D. Lightsey, R. H. Snyder, and E. M. Haubold. (2007). Forensic methods for characterizing watercraft from watercraft-induced wounds on the Florida manatee (*Trichechus manatus latirostris*). *Marine Mammal Science, 23*(1), 110–132.

SeeTurtles.org. (2017). *Coastal Development and Sea Turtles*. Retrieved from http://www.seeturtles.org/coastal-development/.

Sellner, K., G. Doucette, and G. Kirkpatrick. (2003). Harmful algal blooms: Causes, impacts and detection. *Society for Industrial Microbiology, 30*, 383–406.

Soldevilla, M. S., L. P. Garrison, E. Scott-Denton, and R. A. Hart. (2016). *Estimated Bycatch Mortality of Marine Mammals in the Gulf of Mexico Shrimp Otter Trawl Fishery During 2012 to 2014* (NOAA Technical Memorandum NMFS-SEFSC-697). Miami, FL: Southeast Fisheries Science Center.

Starr, M., S. Lair, S. Michaud, M. Scarratt, M. Quilliam, D. Lefaivre, M. Robert, A. Wotherspoon, R. Michaud, N. Menard, G. Sauve, S. Lessard, P. Beland, and L. Measures. (2017). Multispecies mass mortality of marine fauna linked to a toxic dinoflagellate bloom. *PLoS ONE, 12*(5), e0176299.

Texas A&M University. (2011). *2011 Gulf of Mexico "Dead Zone" could be biggest ever*. Retrieved from http://www.sciencedaily.com/releases/2011/07/110718141618.htm.

Texas A&M University. (2014). *Gulf Dead Zone this year is smaller*. Retrieved from http://today.tamu.edu/2014/07/15/gulf-dead-zone-this-year-is-smaller/.

The Canal Connection. (2017). *As the Expanded Canal's Global Impact Grows, U.S. East Coast Ports Begin to Benefit*. Retrieved from http://micanaldepanama.com/expansion.

The Times-Picayune. (2015). *Shell Bringing World's Deepest Floating Oil Production Vessel to Gulf of Mexico*. Retrieved from http://www.nola.com/business/index.ssf/2015/09/shell_turritella_gulf_of_mexic.html.

Tollefson, J. (2017). Air-gun blasts kill plankton. *Nature, 546*, 586–587.

U.S. Army Corps of Engineers. (2012). *Department of the Army Environmental Assessment and Statement of Finding for the modification of the Wallops Island danger zone published 33 CFR section 334.130, "Atlantic Ocean off Wallops Island and Chincoteague Inlet, VA; danger zone"*.

U.S. Coast Guard. (2013). *Final Programmatic Environmental Assessment for the Nationwide Use of High Frequency and Ultra High Frequency Active SONAR Technology*. Washington, DC: U.S. Coast Guard.

U.S. Coast Guard. (2016). *Atlantic Coast Port Access Route Study Final Report*. Washington, DC: Atlantic Coast Port Access Route Study Workgroup.

U.S. Department of Agriculture. (2014). *Census of Aquaculture (2013)*. (AC-12-SS-2). Retrieved from http://www.agcensus.usda.gov/Publications/2012/Online_Resources/Aquaculture/.

U.S. Department of Energy. (2015a). *U.S. Department of Energy Wind and Water Power Technologies Office Funding in the United States: Marine and Hydrokinetic Energy Products*. Washington, DC:

U.S. Department of Energy. Retrieved from http://energy.gov/sites/prod/files/2015/04/f22/MHK-Project-Report-4-14-15.pdf.

U.S. Department of Energy. (2015b). *Marine and Hydrokinetic Energy Research and Development*. Retrieved from http://energy.gov/eere/water/marine-and-hydrokinetic-energy-research-development.

U.S. Department of the Navy. (2000). *Compliance with Environmental Requirements in the Conduct of Naval Exercises or Training at Sea*. Washington, DC: The Under Secretary of the Navy.

U.S. Department of the Navy. (2009a). *VACAPES Range Complex Final Environmental Impact Statement/ Overseas Environmental Impact Statement*. Washington, DC: United States Fleet Forces Command.

U.S. Department of the Navy. (2009b). *Final Overseas Environmental Impact Statement/Environmental Impact Statement for the Undersea Warfare Training Range*. Norfolk, VA: U.S. Department of Defense, U.S. Department of the Navy.

U.S. Department of the Navy. (2009c). *Record of Decision for the Undersea Warfare Training Range*. Washington, DC: U.S. Department of Defense.

U.S. Department of the Navy. (2013a). *Finding of No Significant Impact and Environmental Assessment for the Homeporting of the Littoral Combat Ship on the East Coast of the United States*. Norfolk, VA: U.S. Department of Defense, U.S. Department of the Navy.

U.S. Department of the Navy. (2013b). *Atlantic Fleet Training and Testing Final Environmental Impact Statement/Overseas Environmental Impact Statement*. Norfolk, VA: Naval Facilities Engineering Command Atlantic.

U.S. Department of the Navy. (2014). *Request for Regulation and Letter of Authorization for the Incidental Taking of Marine Mammals Resulting from U.S. Navy Joint Logistics Over-the-Shore Training in Virginia and North Carolina*. Norfolk, VA: Commander, United States Fleet Forces Command.

U.S. Department of the Navy. (2015). *Finding of No Significant Impact and Draft Environmental Assessment for Joint Logistics Over-the-Shore Training at Joint Expeditionary Base Little Creek-Fort Story, Virginia Beach, Virgnia and Marine Corps Base Camp Lejeune, Jacksonville, North Carolina*. Norfolk, VA: U.S. Department of Defense, U.S. Department of the Navy.

U.S. Department of the Navy. (2016). *Draft Supplemental Environmental Impact Statement/Supplemental Overseas Environmental Impact Statement for Surveillance Towed Array Sensor System Low Frequency Active Sonar*. Arlington, VA: U.S. Department of the Navy.

U.S. Department of the Navy. (2017a). *Draft Environmental Assessment for Demolition/Replacement of Pier 32/Demolition of Pier 10 (P-898) at United States Naval Submarine Base New London Groton, Connecticut*. Norfolk, VA: Navy Region Mid-Atlantic.

U.S. Department of the Navy. (2017b). *Marine Mammal Strandings Associated with U.S. Navy Sonar Activities*. San Diego, CA: U.S. Navy Marine Mammal Program and SPAWAR Naval Facilities Engineering Command.

U.S. Environmental Protection Agency. (2016). *2014 National Emissions Inventory*. Retrieved from https://www.epa.gov/air-emissions-inventories/2014-national-emissions-inventory-nei-data.

U.S. Maritime Administration. (2015). *U.S. Waterborne Foreign Container Trade by U.S. Customs Ports (2000–2015)*. Washington, DC: U.S. Department of Transportation.

Van der Hoop, J. M., M. J. Moore, S. G. Barco, T. V. Cole, P. Y. Daoust, A. G. Henry, D. F. McAlpine, W. A. McLellan, T. Wimmer, and A. R. Solow. (2013). Assessment of management to mitigate anthropogenic effects on large whales. *Conservation Biology: The Journal of the Society for Conservation Biology, 27*(1), 121–133.

van Hooidonk, R., J. A. Maynard, D. Manzello, and S. Planes. (2014). Opposite latitudinal gradients in projected ocean acidification and bleaching impacts on coral reefs. *Global Change Biology, 20*(1), 103–112.

Wallace, B. P., R. L. Lewison, S. L. McDonald, R. K. McDonald, C. Y. Kot, S. Kelez, R. K. Bjorkland, E. M. Finkbeiner, S. Helmbrecht, and L. B. Crowder. (2010). Global patterns of marine turtle bycatch. *Conservation Letters, 3*(3), 131–142.

Waycott, M., C. M. Duarte, T. J. B. Carruthers, R. J. Orth, W. C. Dennison, S. Olyarnik, A. Calladine, J. W. Fourqurean, K. L. Heck, Jr., A. R. Hughes, G. A. Kendrick, W. J. Kenworthy, F. T. Short, and S. L. Williams. (2009). Accelerating loss of seagrasses across the globe threatens coastal ecosystems. *Proceedings of the National Academy of Sciences, 106*(30), 12377–12381.

Weilgart, L. (2013). A Review of the Impacts of Seismic Airgun Surveys on Marine Life. *CBD Expert Workshop on Underwater Noise and its Impacts on Marine and Coastal Biodiversity, February 25–27, 2014*, 1–10.

Williams, K. A., I. J. Stenhouse, E. E. Connelly, and S. M. Johnson. (2015). *Mid-Atlantic Wildlife Studies: Distribution and Abundance of Wildlife along the Eastern Seaboard 2012–2014* (Science Communications Series BRI 2015-19). Portland, ME: Biodiversity Research Institute.

Wilson, S. G., and T. R. Fischetti. (2010). *Coastline Population Trends in the United States: 1960 to 2008*. Washington, DC: U.S. Department of Commerce, U.S. Census Bureau.

This page intentionally left blank.

Final
Environmental Impact Statement/Overseas Environmental Impact Statement
Atlantic Fleet Training and Testing Activities

TABLE OF CONTENTS

List of Figures

List of Tables

This page intentionally left blank.

5 MITIGATION

5.1 INTRODUCTION

This chapter describes the mitigation measures that the United States (U.S.) Department of the Navy (Navy) will implement to avoid or reduce potential impacts from the Atlantic Fleet Training and Testing (AFTT) Final Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) Proposed Action. The Navy has been mitigating impacts from military readiness activities throughout areas where it trains and tests for more than two decades. Past environmental documents applicable to the Study Area are discussed in Section 1.2 (The Navy's Environmental Compliance at At-Sea Policy).

The Navy will also implement standard operating procedures specific to training and testing activities conducted under the Proposed Action. In many cases, standard operating procedures provide a benefit to environmental and cultural resources, some of which have high socioeconomic value in the Study Area. Standard operating procedures differ from mitigation measures because standard operating procedures are designed to provide for safety and mission success, whereas mitigation measures are designed specifically to avoid or reduce potential environmental impacts. An example of a standard operating procedure is that ships operated by or for the Navy have personnel assigned to stand watch at all times when underway. Watch personnel monitor their assigned sectors for any indication of danger to the ship and the personnel on board, such as a floating or partially submerged object or piece of debris, periscope, surfaced submarine, wisp of smoke, flash of light, or surface disturbance. As a standard collision avoidance procedure, watch personnel also monitor for marine mammals that have the potential to be in the direct path of the ship. The standard operating procedures to avoid collision hazards are designed for safety of the ship and personnel on board. This is different from mitigation measures for vessel movement, which require vessels to maneuver to avoid marine mammals by specified distances to avoid or reduce the potential for physical disturbance and strike of marine mammals, as described in Section 5.3.4.1 (Vessel Movement). In this example, the benefit of the mitigation measure for vessel movement is additive to the benefit of the standard operating procedure for vessel safety. A full discussion of standard operating procedures is provided in Section 2.3.3 (Standard Operating Procedures).

In addition to the mitigation measures and standard operating procedures specific to the Proposed Action, the Navy has existing routine operating instructions (e.g., training manuals) and local installation instructions (e.g., Integrated Natural Resource Management Plans) that were developed to meet other safety and environmental compliance requirements or initiatives. For example, the Naval Air Training and Operating Procedures Standardization (NATOPS) General Flight and Operating Instructions Manual (CNAF M-3710.7) contains naval air training procedures pertaining to safe operations of aircraft, which includes requirements to minimize the disturbance of wildlife. Aviation units are required to avoid noise-sensitive areas, such as breeding farms, resorts, beaches, national parks, national monuments, and national recreational areas. They are also required to avoid disturbing wild fowl in their natural habitats and to avoid firing directly at large fish, whales, or other wildlife. These requirements are in addition to any measures identified for the Proposed Action. The Navy will continue complying with applicable operating instructions and local installation instructions within the Study Area, as appropriate.

5.1.1 BENEFITS OF MITIGATION

The Chapter 3 (Affected Environment and Environmental Consequences) environmental analyses indicate that certain acoustic, explosive, and physical disturbance and strike stressors have the potential to impact certain biological or cultural resources. The Navy developed mitigation measures for those stressors and will implement the mitigation for either action alternative. The Navy considered the benefits of mitigation in the environmental analyses for both Alternative 1 and Alternative 2 of the Proposed Action in this Final EIS/OEIS. In addition to analyzing mitigation measures pursuant to the National Environmental Policy Act (NEPA), the Navy designed its mitigation measures to achieve one or more benefits, such as the following:

- Effect the least practicable adverse impact on marine mammal species or stocks and their habitat, and have a negligible impact on marine mammal species and stocks (as required under the Marine Mammal Protection Act [MMPA]);
- Ensure that the Proposed Action does not jeopardize the continued existence of endangered or threatened species, or result in destruction or adverse modification of critical habitat (as required under the Endangered Species Act [ESA]);
- Avoid or minimize adverse effects on essential fish habitat (as required under the Magnuson-Stevens Fishery Conservation and Management Act); and
- Avoid adversely impacting historic shipwrecks (as required under the Abandoned Shipwreck Act and National Historic Preservation Act).

The Navy coordinated its mitigation with the appropriate regulatory agencies, including the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS), through the consultation and permitting processes. The Navy and NMFS Records of Decision, MMPA Regulations and Letters of Authorization, and ESA Biological Opinion will document the mitigation measures that the Navy will implement under the Proposed Action. Should the Navy require a change in how it implements mitigation based on national security concerns, evolving readiness requirements, or other factors (e.g., significant changes in the best available science), the Navy will engage the appropriate agencies and reevaluate its mitigation through adaptive management or the appropriate consultations. The Navy's adaptive management approach is discussed in Section 5.1.2.2.1.1 (Adaptive Management). This approach was coordinated with NMFS during the consultation and permitting processes and will be included in the MMPA Regulations and Letters of Authorization.

5.1.2 Compliance Initiatives

To disseminate its mitigation requirements to the appropriate personnel and meet other compliance requirements for the MMPA and ESA, the Navy will continue using the Protective Measures Assessment Protocol and its ongoing monitoring and reporting initiatives, as described in the sections below.

5.1.2.1 Protective Measures Assessment Protocol

To disseminate requirements to the personnel who are required to implement mitigation during training and testing activities, the Navy will continue inputting its mitigation measures into the Protective Measures Assessment Protocol and appropriate governing instructions. The Protective Measures Assessment Protocol is a software tool that serves as the Navy's comprehensive data source for at-sea mitigation. The software tool provides personnel with notification of the required mitigation measures and a visual display of the planned training or testing activity location overlaid with relevant environmental data (e.g., mapped locations of shallow-water coral reefs). Navy policy requires applicable personnel to access the Protective Measures Assessment Protocol during the event planning process. This helps ensure that personnel receive mitigation instructions prior to the start of training and testing activities and that mitigation is implemented appropriately.

5.1.2.2 Monitoring, Research, and Reporting Initiatives

Many of the Navy's monitoring programs, research programs, and reporting initiatives have been ongoing for more than a decade and will continue as a compliance requirement for the MMPA, ESA, or both. The Navy is adding an ESA-listed coral and military expended material effects reporting initiative under Phase III as a new compliance requirement for the ESA, as described in Section 5.1.2.2.3 (Incident Reports). The Navy and NMFS will use the information contained within monitoring, research, activity, and incident reports when evaluating the effectiveness and practicality of mitigation and determining if adaptive adjustments to mitigation may be appropriate. These reports also facilitate better understandings of the biological resources that inhabit the Study Area and the potential impacts of the Proposed Action on those resources.

5.1.2.2.1 Marine Species Research and Monitoring Programs

Through its marine species research and monitoring programs, the Navy is one of the nation's largest sponsors of scientific research on and monitoring of marine species. Detailed information on these programs is provided in Section 3.0.1.1 (Marine Species Monitoring and Research Programs). Navy research programs focus on investments in basic and applied research that increase fundamental knowledge and advance naval technological capabilities. Navy monitoring programs focus on the potential impacts of training and testing activities on biological resources. Monitoring reports are available to the public on the U.S. Navy Marine Species Monitoring webpage. The Navy will post future reports online as they become available. Specific details regarding the content of the reports were coordinated with the appropriate agencies through the consultation and permitting processes. Additional information about the U.S. Navy Marine Species Monitoring Program, including its adaptive management and strategic planning components, is provided in the sections below.

5.1.2.2.1.1 Adaptive Management

Adaptive management is an iterative process of decision-making that accounts for changes in the environment and scientific understanding over time through a system of monitoring and feedback. Within the natural resource management community, adaptive management involves ongoing, real-time learning and knowledge creation, both in a substantive sense and in terms of the adaptive process itself (Williams et al., 2009). Adaptive management focuses on learning and adapting, through partnerships of natural resource managers, scientists, and other stakeholders. Adaptive management helps managers maintain flexibility in their decisions and provides them the latitude to change direction to improve understanding of ecological systems and achieve management objectives. Working to improve progress toward desired outcomes is another function of adaptive management.

The Navy's adaptive management review process and reporting requirements serve as the basis for evaluating performance and compliance. The process involves technical review meetings and ongoing discussions between the Navy, NMFS, the Marine Mammal Commission, and other experts in the scientific community. An example of a revision to the compliance monitoring structure as a result of adaptive management is the development of the Strategic Planning Process, which is a planning tool for the selection and management of monitoring investments (U.S. Department of the Navy, 2013). Through adaptive management, the Strategic Planning Process has been incorporated into the Integrated Comprehensive Monitoring Program, which is described below.

5.1.2.2.1.2 Integrated Comprehensive Monitoring Program

The Navy developed an Integrated Comprehensive Monitoring Program to serve as the overarching framework for coordinating its marine species monitoring efforts and as a planning tool to focus its monitoring priorities pursuant to ESA and MMPA requirements (U.S. Department of the Navy, 2010). The purpose of the Integrated Comprehensive Monitoring Program is to coordinate monitoring efforts across regions and to allocate the most appropriate level and type of monitoring effort for each range complex based on a set of standardized objectives, regional expertise, and resource availability. The Integrated Comprehensive Monitoring Program does not identify specific field work or individual projects. It is designed to provide a flexible, scalable, and adaptable framework using adaptive management and the Strategic Planning Process to periodically assess progress and reevaluate objectives.

The Integrated Comprehensive Monitoring Program is evaluated through the adaptive management review process to: (1) assess progress, (2) provide a matrix of goals and objectives, and (3) make recommendations for refinement and analysis of monitoring and mitigation techniques. This process includes conducting an annual adaptive management review meeting where the Navy and NMFS jointly consider the prior year's goals, monitoring results, and related scientific advances to determine if monitoring plan modifications are warranted to address program goals more effectively. Modifications to the Integrated Comprehensive Monitoring Program that result from annual adaptive management review discussions are incorporated by an addendum or revision to the Integrated Comprehensive Monitoring Program as needed. The Integrated Comprehensive Monitoring Program will be routinely updated as the program evolves and progresses.

The Strategic Planning Process serves to guide the investment of resources to most efficiently address Integrated Comprehensive Monitoring Program objectives and intermediate scientific objectives. Navy-funded monitoring projects relating to the impact of Navy training and testing activities on protected marine species are designed to accomplish one or more of the following top-level goals, as described in the Integrated Comprehensive Monitoring Program charter:

- Increase the understanding of the likely occurrence of marine mammals and ESA-listed marine species in the vicinity of the action (e.g., presence, abundance, distribution, density).
- Increase the understanding of the nature, scope, or context of the likely exposure of marine mammals and ESA-listed marine species to any of the potential stressors associated with the action (e.g., acoustics, explosives, physical disturbance and strike of military expended materials) through a better understanding of one or more of the following: (1) the nature of the action and its surrounding environment (e.g., sound-source characterization, propagation, ambient noise levels), (2) the affected species (e.g., life history, dive patterns), (3) the likely co-occurrence of marine mammals and ESA-listed marine species with the action (in whole or part), and (4) the likely biological or behavioral context of exposure to the stressor for the marine mammal and ESA-listed marine species (e.g., age class of exposed animals or known pupping, calving, or feeding areas).
- Increase the understanding of how individual marine mammals or ESA-listed marine species respond behaviorally or physiologically to the specific stressors associated with the action and in what context (e.g., at what distance or received level).
- Increase the understanding of how anticipated individual responses to individual stressors or anticipated combinations of stressors may impact either: (1) the long-term fitness and survival of an individual, or (2) the population, species, or stock (e.g., through impacts on annual rates of recruitment or survival).
- Increase the understanding of the effectiveness of mitigation and monitoring.

- Improve the understanding and record of the manner in which the Navy complies with its Incidental Take Authorizations and Incidental Take Statements.
- Increase the probability of detecting marine mammals through improved technology or methods within the mitigation zones (to improve mitigation effectiveness) and generally (to better achieve monitoring goals).

The Navy established a Scientific Advisory Group in 2011 with the initial task of evaluating current Navy monitoring approaches under the Integrated Comprehensive Monitoring Plan and existing MMPA Regulations and Letters of Authorization. The Scientific Advisory Group was also tasked with developing objective scientific recommendations that would form the basis for the Strategic Plan. While recommendations were fairly broad and not specifically prescriptive, the Scientific Advisory Group did provide specific programmatic recommendations that serve as guiding principles for the continued evolution of the Integrated Comprehensive Monitoring Program. Key recommendations included:

- Working within a conceptual framework of knowledge, from basic information on the occurrence of species within each range complex, to more specific matters of exposure, response, and consequences.
- Facilitating collaboration among researchers in each region, with the intent to develop a coherent and synergistic regional monitoring and research effort.
- Striving to move away from effort-based compliance metrics (e.g., completing a pre-determined amount of survey hours or days), with the intent to design and conduct monitoring projects according to scientific objectives rather than effort expended.
- Approaching the monitoring program holistically and selecting projects that offer the best opportunity to advance understanding of the issues, as opposed to establishing range-specific requirements.

5.1.2.2.1.3 Strategic Planning Process

The U.S. Navy Marine Species Monitoring Program has evolved and improved as a result of adaptive management review and the Strategic Planning Process through changes that include:

- Recognizing the limitations of effort-based compliance metrics;
- Developing a strategic approach to monitoring based on recommendations from the Scientific Advisory Group;
- Shifting focus to projects based on scientific objectives that facilitate generation of statistically meaningful results upon which natural resources management decisions may be based;
- Focusing on priority species or areas of interest as well as best opportunities to address specific monitoring objectives to maximize return on investment; and
- Increasing transparency of the program and management standards, improving collaboration among participating researchers, and improving accessibility to monitoring data and results.

As a result of the changes outlined above due to the implementation of the Strategic Planning Process, the U.S. Navy Marine Species Monitoring Program has undergone a transition. Intermediate scientific objectives now serve as the basis for developing and executing new monitoring projects across Navy training and testing areas in the Atlantic and Pacific Oceans. Implementation of the Strategic Planning Process involves coordination among fleets, system commands, Chief of Naval Operations Energy and Environmental Readiness Division, NMFS, and the Marine Mammal Commission with five primary steps:

- **Identify overarching intermediate scientific objectives.** Through the adaptive management process, the Navy coordinates with NMFS and the Marine Mammal Commission to review and revise the list of intermediate scientific objectives that guide development of individual monitoring projects. Examples include addressing information gaps in species occurrence and density, evaluating behavioral responses of marine mammals to Navy training and testing activities, and developing tools and techniques for passive acoustic monitoring.
- **Develop individual monitoring project concepts.** This step generally takes the form of soliciting input from the scientific community in terms of potential monitoring projects that address one or more of the intermediate scientific objectives. This can be accomplished through a variety of forums, including professional societies, regional scientific advisory groups, and contractor support.
- **Evaluate, prioritize, and select monitoring projects.** Navy technical experts and program managers review and evaluate monitoring project concepts and develop a prioritized ranking. The goal of this step is to establish a suite of monitoring projects that address a cross-section of intermediate scientific objectives spread over a variety of range complexes.
- **Execute and manage selected monitoring projects.** Individual projects are initiated through appropriate funding mechanisms and include clearly defined objectives and deliverables, such as data, reports, or publications.
- **Report and evaluate progress and results.** Progress on individual monitoring projects is updated through the U.S. Navy Marine Species Monitoring Program website as well as annual monitoring reports submitted to NMFS. Both internal review and discussions with NMFS through the adaptive management process are used to evaluate progress toward addressing the primary objectives of the Integrated Comprehensive Monitoring Program and serve to periodically recalibrate the focus of the monitoring program.

These steps serve three primary purposes: (1) to facilitate the Navy in developing specific projects addressing one or more intermediate scientific objectives, (2) to establish a more structured and collaborative framework for developing, evaluating, and selecting monitoring projects across areas where the Navy conducts training and testing activities, and (3) to maximize the opportunity for input and involvement across the research community, academia, and industry. This process is designed to integrate various elements, including:

- Integrated Comprehensive Monitoring Program top-level goals,
- Scientific Advisory Group recommendations,
- Integration of regional scientific expert input,
- Ongoing adaptive management review dialog between NMFS and the Navy,
- Lessons learned from past and future monitoring of Navy training and testing, and
- Leveraging of research and lessons learned from other Navy-funded science programs.

The Strategic Planning Process will continue to shape the future of the U.S. Navy Marine Species Monitoring Program and serve as the primary decision-making tool for guiding investments. Information on monitoring projects currently underway in the Atlantic and Pacific oceans, as well as results, reports, and publications, can be accessed through the U.S. Navy Marine Species Monitoring Program website.

5.1.2.2.2 Training and Testing Activity Reports

The Navy developed a classified data repository known as the Sonar Positional Reporting System to maintain an internal record of underwater sound sources (e.g., active sonar) used during training and testing. The Sonar Positional Reporting System facilitates reporting pursuant to the Navy's MMPA Regulations and Letters of Authorization. Using data from the Sonar Positional Reporting System and other relevant sources, the Navy will continue to provide the NMFS Office of Protected Resources with classified or unclassified (depending on the data) annual reports on the training and testing activities that use underwater sound sources. In its annual training and testing activity reports, the Navy will describe the level of training and testing conducted during the reporting period. For example, the Navy will report the location and total hours and counts of active sonar hours and in-water explosives used, and an assessment if activities conducted in the Study Area exceeded levels of training and testing analyzed in the MMPA authorization and ESA Biological Opinion. For major training exercises, the reports will also include information on each individual marine mammal sighting related to mitigation implementation. Unclassified annual training and testing activity reports that have been submitted to NMFS can be found on the NMFS Office of Protected Resources and U.S. Navy Marine Species Monitoring Program webpages.

5.1.2.2.3 Incident Reports

The Navy's mitigation measures and many of its standard operating procedures are designed to prevent incidents involving biological and cultural resources, such as aircraft strikes, vessel strikes, and impacts on submerged historic properties and seafloor resources. The Navy has been collecting data on such incidents (if they have occurred) for more than a decade and will continue doing so under the Proposed Action. To provide information on incidents involving biological or cultural resources, the Navy will submit reports to the appropriate management authorities, as described below:

- **Birds and Bats:** As described in Section 2.3.3.3 (Aircraft Safety), animal strikes present an aviation safety risk for aircrews and aircraft. The Navy will report all bird and bat strikes per standard operating procedures.
- **Marine Mammals, Sea Turtles, and ESA-Listed Species:** The Navy will notify the appropriate regulatory agency, which may include NMFS or the USFWS, immediately or as soon as operational security considerations allow if it observes the following that is (or may be) attributable to Navy activities: (1) a vessel strike of a marine mammal or sea turtle during training or testing, (2) a stranded, injured, or dead marine mammal or sea turtle during training or testing, or (3) an injured or dead marine mammal, sea turtle or ESA-listed species during post-explosive event monitoring. The Navy will provide relevant information pertaining to the incident (e.g., vessel speed). Additional details on these incident reporting requirements will be included in the Notification and Reporting Plan. For manatee incidents, the agency contacts may include the Florida Fish and Wildlife Conservation Commission, Law Enforcement Division; the USFWS Jacksonville Ecological Field Office; the USFWS Raleigh Field Office; and the North Carolina Wildlife Resources Commission. If harassment, injury, or death of a manatee is observed, the Navy will immediately halt the training or testing activity. The Navy will continue to provide the appropriate personnel with training on marine species incidents and their associated reporting requirements to aid the data collection and reporting processes (see Section 5.3.1, Environmental Awareness and Education). Information on marine mammal strandings is included in the *Marine Mammal Strandings Associated with U.S. Navy Sonar Activities* technical report (U.S. Department of the Navy, 2017a).
- **ESA-Listed Coral:** The Navy will evaluate the extent to which military expended materials may have impacted ESA-listed corals and designated coral critical habitat in or near the Key West Range Complex through two initiatives: (1) evaluating existing data to determine whether there is past evidence of impacts, and (2) working with entities already conducting underwater

surveys to incorporate searches for potential military expended materials in future scheduled surveys to determine if there are any observed impacts from those materials. Details of the reporting process and requirements will be included in the Navy's coordination and evaluation plan, which will be developed in cooperation with the NMFS ESA Interagency Cooperation Division and relevant entities (e.g., National Marine Sanctuaries Program, NOAA Marine Debris program, relevant coral researchers).

- **Cultural Resources:** In the event the Navy impacts a submerged historic property (e.g., archaeological resource), it will commence consultation with the appropriate State Historic Preservation Officer or Tribal Historic Preservation Officer in accordance with 36 Code of Federal Regulations section 800.13(b)(3).

5.2 Mitigation Development Process

The Navy, in coordination with the appropriate regulatory agencies, developed its initial suite of mitigation measures for Phase I of environmental planning (2009–2014) and subsequently revised those mitigation measures for Phase II (2013–2018). For this Final EIS/OEIS (which represents Phase III of environmental planning), the Navy worked collaboratively with the appropriate regulatory agencies to develop and finalize its mitigation through the consultation and permitting processes. The mitigation development process involved reanalyzing existing Phase II measures and analyzing new mitigation recommendations received from Navy and NMFS scientists, other governmental agencies, the public, and non-governmental organizations during the NEPA, consultation, and permitting processes. The Navy conducted a detailed review and assessment of each potential mitigation measure individually and then all potential mitigation measures collectively to determine if, as a whole, mitigation will effectively avoid or reduce potential impacts from the Proposed Action and will be practical to implement. The Navy operational community (i.e., leadership from the aviation, surface, subsurface, and special warfare communities; leadership from the research and acquisition community; and training and testing experts), environmental planners, and scientific experts provided input on the effectiveness and practicality of mitigation implementation. A four-star Admiral, the Fleet Commander of all Navy forces in the Study Area, and Navy Senior Leadership reviewed and approved the suite of mitigation measures included in this Final EIS/OEIS and determined it is the highest level of mitigation practical for the Navy to implement under the Proposed Action.

Mitigation measures that the Navy will implement under the Proposed Action are organized into two categories: procedural mitigation measures and mitigation areas. The sections below provide definitions of mitigation terminology, background information pertinent to the mitigation development process, and information about the mitigation effectiveness and practicality criteria. Additional activity or stressor-specific details, such as the level of effect to which a procedural mitigation measure is expected to mitigate and if a measure has been modified from Phase II is provided throughout Section 5.3 (Procedural Mitigation to be Implemented) and Section 5.4 (Mitigation Areas to be Implemented). Section 5.5 (Measures Considered but Eliminated) contains information on measures that did not meet the appropriate balance between being effective and practical to implement, and therefore will not be implemented under the Proposed Action.

5.2.1 Procedural Mitigation Development

Procedural mitigation is mitigation that the Navy will implement whenever and wherever training or testing activities involving applicable acoustic, explosive, and physical disturbance and strike stressors take place within the Study Area. Procedural mitigation generally involves: (1) the use of one or more trained Lookouts to observe for specific biological resources within a mitigation zone, (2) requirements for Lookouts to immediately communicate sightings of specific biological resources to the appropriate watch station for information dissemination, and (3) requirements for the watch station to implement mitigation until a pre-activity commencement or during-activity recommencement condition has been met.

Procedural mitigation primarily involves Lookouts observing for marine mammals and sea turtles. For some activities, Lookouts may also be required to observe for additional biological resources, such as marine birds, fish, jellyfish aggregations, or floating vegetation. In this chapter, the term "floating vegetation" refers specifically to floating concentrations of detached kelp paddies and *Sargassum*. Some biological resources, such as floating vegetation, can be indicators of potential marine mammal or sea turtle presence because marine mammals or sea turtles have been known to seek shelter in, feed on, or feed among them. For example, young sea turtles have been known to hide from predators and eat the algae associated with floating concentrations of *Sargassum*. The Navy observes for these additional biological resources prior to the initial start or during the conduct of certain activities to protect ESA-listed species or to offer an additional layer of protection for marine mammals and sea turtles.

To consider the benefits of procedural mitigation to marine mammals and sea turtles within the MMPA and ESA impact estimates, the Navy conservatively factored mitigation effectiveness into its quantitative analysis process, as described in the technical report titled *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2018a). The Navy's quantitative analysis assumes that Lookouts will not be 100 percent effective at detecting all individual marine mammals and sea turtles within the mitigation zones for each activity. This is due to the inherent limitations of observing marine species and because the likelihood of sighting individual animals is largely dependent on observation conditions (e.g., time of day, sea state, mitigation zone size, observation platform) and animal behavior (e.g., the amount of time an animal spends at the surface of the water). This is particularly true for sea turtles, small marine mammals, and marine mammals that display cryptic behaviors (e.g., surfacing to breathe with only a small portion of their body visible from the surface). Throughout Section 5.3 (Procedural Mitigation to be Implemented), discussions about the likelihood that a Lookout would observe a marine mammal or sea turtle pertain specifically to animals that are available to be observed (i.e., on, above, or just below the water's surface). The benefits of procedural mitigation measures for species that were not included in the quantitative analysis process (e.g., birds, fish) are discussed qualitatively.

Data inputs for assessing and developing procedural mitigation included operational data as described in Section 5.2.3 (Practicality of Implementation), the best available science discussed in Chapter 3 (Affected Environment and Environmental Consequences), published literature, data on marine mammal and sea turtle impact ranges obtained through acoustic modeling, marine species monitoring and density data, and the most recent guidance from NMFS and the USFWS. Background information on the data that were used to develop the ranges to effect for marine mammals and sea turtles (such as hearing threshold metrics) is provided in Chapter 3.7 (Marine Mammals) and Chapter 3.8 (Reptiles).

5.2.1.1 Lookouts

Lookouts perform similar duties as standard watch personnel (e.g., personnel on the bridge watch team and personnel stationed for man-overboard precautions, as described in Section 2.3.3, Standard Operating Procedures), but are designated the responsibility of helping meet the Navy's mitigation requirements by visually observing mitigation zones. The number of Lookouts designated for each training or testing activity is dependent upon the number of personnel involved in the activity (i.e., manning restrictions) and the number and type of assets available (i.e., equipment and space restrictions).

Depending on the activity, a Lookout may be positioned on a ship (i.e., surface ships and surfaced submarines), on a small boat (e.g., rigid-hull inflatable boat), in an aircraft, on a pier, or on the shore. Certain platforms, such as aircraft and small boats, have manning or space restrictions; therefore, the Lookout on these platforms is typically an existing member of the aircraft or boat crew who is responsible for other essential tasks (e.g., a pilot who is also responsible for navigation). Some platforms (e.g., the Littoral Combat Ship) are minimally manned and are therefore either physically unable to accommodate more than one Lookout or divert personnel from mission-essential tasks, including safe and secure operation of propulsion, weapons, and damage control systems that ensure the safety of the ship and the personnel on board. The number of Lookouts specified for each activity in Section 5.3 (Procedural Mitigation to be Implemented) represents the maximum number of Lookouts that can be designated for those activities without requiring additional personnel or reassigning duties. The Navy is unable to position Lookouts on unmanned surface vehicles, unmanned aerial systems, unmanned underwater vehicles, and submerged submarines, or have Lookouts observe during activities that use systems deployed from or towed by unmanned platforms.

When Lookouts are positioned in a fixed-wing aircraft or rotary-wing aircraft (i.e., helicopter), mission requirements determine the flight parameters (altitude, flight path, and speed) for that aircraft. For example, most fixed-wing aircraft sorties occur above 3,000 feet (ft.), while most rotary-wing sorties associated with mine countermeasure activities occur at altitudes as low as 75–100 ft. Similarly, when Lookouts are positioned on a vessel, mission requirements determine the operational parameters (course and speed) for that vessel.

The Navy's passive acoustic devices (e.g., remote acoustic sensors, expendable sonobuoys, passive acoustic sensors on submarines) can complement visual observations for marine mammals when passive acoustic assets are already participating in an activity. The passive acoustic devices can detect vocalizing marine mammals within the frequency bands already being monitored by Navy personnel. Marine mammal detections from passive acoustic devices can alert Lookouts to possible marine mammal presence in the vicinity. Lookouts can use the information from passive acoustic detections to assist their visual observations of the mitigation zone. Based on the number and type of passive acoustic devices that are typically used, passive acoustic detections do not provide range or bearing to a detected animal in order to determine its location or confirm its presence in a mitigation zone. Therefore, it is not practical for the Navy to implement mitigation in response to passive acoustic detections alone (i.e., without a visual sighting of an animal within the mitigation zone). Additional information about passive acoustic devices is provided in Section 5.5.3 (Active and Passive Acoustic Monitoring Devices).

5.2.1.2 Mitigation Zones

Mitigation zones are areas at the surface of the water within which applicable training or testing activities will be ceased, powered down, or modified to protect specific biological resources from an auditory injury (permanent threshold shift [PTS]), non-auditory injury (from impulsive sources), or direct strike (e.g., vessel strike) to the maximum extent practicable. Mitigation zones are measured as the radius from a stressor. Implementation of procedural mitigation is most effective when mitigation zones are appropriately sized to be realistically observed during typical training and testing activity conditions.

The Navy customized its mitigation zone sizes and mitigation requirements for each applicable training and testing activity category or stressor. The Navy developed each mitigation zone to be the largest area Lookouts can reasonably be expected to observe during typical activity conditions (i.e., the most environmentally protective) and the Navy can commit to implementing mitigation without impacting safety, sustainability, and the ability to meet mission requirements. The Navy designed the mitigation zones for most acoustic and explosive stressors according to its source bins. As described in Section 3.0.3.3.1.1 (Sonar and Other Transducers), sonars and other transducers are grouped into classes that share an attribute, such as frequency range or purpose of use. Classes are further sorted by bins based on the frequency or bandwidth, source level, and when warranted, the application in which the source would be used. As described in Section 3.0.3.3.2.1 (Explosions in Water), explosives detonated in water are binned by net explosive weight. Mitigation does not pertain to stressors that do not have the potential to impact biological resources (e.g., *de minimis* acoustic and explosive sources that do not have the potential to impact marine mammals).

Discussions throughout Section 5.3 (Procedural Mitigation to be Implemented) about the level of effect that will likely be mitigated are based on a comparison of the mitigation zone size to the predicted impact ranges for the applicable source bins with the longest average ranges to PTS. These conservative discussions represent the worst-case scenario for each activity category or stressor. The mitigation zones will oftentimes cover all or a larger portion of the predicted average ranges to PTS for other comparatively smaller sources with shorter impact ranges (e.g., sonar sources used at a lower source level, explosives in a smaller bin). The discussions are primarily focused on how the mitigation zone sizes compare to the ranges to PTS; however, depending on the activity category or stressor, the mitigation zones are oftentimes large enough to also mitigate within a portion of the ranges to temporary threshold shift (TTS). TTS is a threshold shift that is recoverable. Background information on PTS, TTS, and marine mammal and sea turtle hearing groups is presented in the U.S. Department of the Navy (2017d) technical report titled *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)*.

5.2.1.3 Procedural Mitigation Implementation

The Navy takes several courses of action in response to a sighting of an applicable biological resource in a mitigation zone. First, a Lookout will communicate the sighting to the appropriate watch station. Next, the watch station will implement the prescribed mitigation, such as delaying the initial start of an activity, powering down sonar, ceasing an explosive detonation, or maneuvering a vessel. If floating vegetation is observed in the mitigation zone prior to the initial start of an activity, the activity will either be relocated to an area where floating vegetation is not observed in concentrations, or the initial start of the activity will be delayed until the mitigation zone is clear of floating vegetation concentrations. There are no requirements to cease activities if vegetation floats into the mitigation zone after activities commence. For sightings of marine mammals, sea turtles, and other specified biological resources within a mitigation zone prior to the initial start of or during applicable activities, the Navy will continue mitigating until one of the five conditions listed below has been met. The conditions are designed to allow a sighted animal to leave the mitigation zone before the initial start of an activity or before an activity resumes.

- The animal is observed exiting the mitigation zone;
- The animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the stressor source;
- The mitigation zone has been clear from any additional sightings for a specific wait period;

- For mobile activities, the stressor source has transited or has been relocated a distance equal to double the mitigation zone size beyond the location of the last sighting; or
- For activities using hull-mounted sonar, the ship concludes that dolphins are deliberately closing in on the ship to ride the ship's bow wave and are therefore out of the main transmission axis of the sonar (and there are no other marine mammal sightings within the mitigation zone).

To supplement the implementation of procedural mitigation, the Navy has agreed to undertake reporting initiatives for certain activities or resources based on previous consultations with NMFS and the USFWS, as summarized in Section 5.1.2.2 (Monitoring, Research, and Reporting Initiatives) and detailed where applicable in Section 5.3 (Procedural Mitigation to be Implemented). For some activities, the Navy also agreed during previous consultations with NMFS or the USFWS to adapt some of its procedural mitigation for particular resources at certain locations and plans to continue those mitigation measures for Phase III. For example, the Navy will continue implementing seasonal mitigation measures for line charge testing activities for ESA-listed Gulf Sturgeon, as discussed in Section 5.3.3.10 (Line Charge Testing).

5.2.2 Mitigation Area Development

Mitigation areas are geographic locations within the Study Area where the Navy will implement mitigation measures to: (1) avoid or reduce potential impacts on biological or cultural resources that are not observable by Lookouts from the water's surface (i.e., resources for which procedural mitigation cannot be implemented), (2) in combination with procedural mitigation, effect the least practicable adverse impact on marine mammal species or stocks and their habitat, or (3) in combination with procedural mitigation, ensure that the Proposed Action does not jeopardize the continued existence of endangered or threatened species, or result in destruction or adverse modification of critical habitat.

The Navy completed an extensive assessment of the Study Area to develop the mitigation areas included in this Final EIS/OEIS. The Navy reanalyzed existing Phase II mitigation areas; assessed additional habitat areas suggested by the public, NMFS, other governmental agencies, and non-governmental organizations; and considered other habitats identified internally by the Navy. Data inputs for mitigation area assessment and development included the operational information described in Section 5.2.3 (Practicality of Implementation), the best available science discussed in Chapter 3 (Affected Environment and Environmental Consequences), published literature, predicted activity impact footprints, and marine species monitoring and density data. The Navy considered a mitigation area to be effective if it met the following criteria:

- **The mitigation area is a key area of biological or ecological importance or contains cultural resources:** The best available science suggests that the mitigation area contains submerged cultural resources (e.g., shipwrecks) or is particularly important to one or more species or resources for a biologically important life process (i.e., foraging, migration, reproduction) or ecological function (e.g., shallow-water coral reefs that provide critical ecosystem functions); and
- **The mitigation will result in an avoidance or reduction of impacts:** Implementing the mitigation will likely avoid or reduce potential impacts on: (1) species, stocks, or populations of marine mammals based on data regarding their seasonality, density, and behavior; or (2) other biological or cultural resources based on their distribution and physical properties. Furthermore, implementing the mitigation will not shift or transfer adverse effects from one species to another (e.g., to a more vulnerable or sensitive species).

Potential impacts on environmental and cultural resources cannot occur unless there is an overlap between a resource and a stressor. During the mitigation assessment and development process, the Navy did not develop mitigation areas in locations where stressors are not used because doing so would not meet the basic definition of effective mitigation (i.e., the mitigation areas would not effectively avoid or reduce potential impacts). For example, some explosive activities cannot realistically be conducted in certain areas based on operational requirements relating to water depth; therefore, mitigation to avoid conducting explosives in these locations is not warranted.

The benefits of mitigation areas are discussed qualitatively and have not been factored into the quantitative analysis process or reductions in take for MMPA and ESA impact estimates. Marine mammal mitigation areas are designed to help avoid or reduce potential impacts during biologically important life processes within particularly important habitat areas. Therefore, the mitigation benefit is discussed in terms of the context of impact avoidance or reduction. A discussion of the mitigation areas developed for this Final EIS/OEIS is presented in Section 5.4 (Mitigation Areas to be Implemented).

5.2.3 Practicality of Implementation

Mitigation measures are expected to have some degree of impact on the training and testing activities that implement them (e.g., modifying where and when activities occur, ceasing an activity in response to a sighting). The Navy is willing to accept a certain level of impact on its military readiness activities because of the substantial benefit that mitigation measures provide for avoiding or reducing impacts on environmental and cultural resources. The Navy's focus during mitigation assessment and development was that mitigation measures must meet the appropriate balance between being effective and practical to implement. To evaluate practicality, the Navy operational community conducted an extensive and comprehensive assessment to determine how and to what degree potential mitigation measures would be compatible with planning, scheduling, and conducting training and testing activities under the Proposed Action in order to meet the Navy's Title 10 requirements.

5.2.3.1 Assessment Criteria

The purpose and need of the Proposed Action is to ensure that the Navy meets its mission to maintain, train, and equip combat-ready naval forces capable of winning wars, deterring aggression, and maintaining freedom of the seas. The Navy is statutorily mandated to protect U.S. national security by being ready, at all times, to effectively prosecute war and defend the nation by conducting operations at sea, as outlined in Title 10 section 5062 of the United States Code. The Navy's mission is achieved in part by conducting training and testing within the Study Area in accordance with established Navy military readiness requirements. Training requirements have been developed through many years of iteration and adaptation and are designed to ensure that Sailors achieve the levels of readiness needed to properly respond to the multitude of contingencies they may face during military missions and combat operations. Activities are planned and scheduled in accordance with the Optimized Fleet Response Plan, which details instructions on manning distribution, range scheduling, operational requirements, maintenance and modernization plans, quality of work and life for personnel, achieving training capabilities, and meeting strategic readiness objectives. There are certain geographic areas, such as the coastal zone, where the Navy does not typically plan certain training or testing activities due to operational parameters (e.g., water depth) and planning considerations (e.g., ensuring public safety), as discussed in Section 2.3.3 (Standard Operating Procedures) and Appendix A (Navy Activity Descriptions).

To achieve the highest skill proficiency and most accurate testing results possible, the Navy conducts activities in a variety of realistic tactical oceanographic and environmental conditions. Such conditions include variations in bathymetry, topography, surface fronts, and sea surface temperatures. Training activities must be as realistic as possible to provide the experiences vital to success and survival during military missions and combat operations. Degraded training would result in units being unqualified to conduct their range of military operations required by operational Commanders. The inability of such Commanders to meet security objectives would result in not only the increased risk to life, but also the degradation of national security. Testing activities must be as realistic as possible for the Navy to conduct accurate acoustic research to validate acoustic models; conduct accurate engineering tests of acoustic sources, signal processing algorithms, and acoustic interactions; and to effectively test systems and platforms (and components of these systems and platforms) to validate whether they perform as expected and determine whether they are operationally effective, suitable, survivable, and safe for their intended use by the fleet. Testing must be completed before full-scale production or delivery to the fleet to ensure functionality and accuracy in military mission and combat conditions.

As described in Chapter 2 (Description of Proposed Action and Alternatives), the Navy requires access to sea space and airspace throughout the Study Area within range complexes, pierside locations, nearshore areas, and large-scale open ocean areas of the high seas. Each area plays a critical role in the Navy's ability to plan, schedule, and effectively execute military readiness activities. The locations where training and testing occur must be situated in a way that allows the Navy to complete its activities without physical or logistical obstructions. The Navy requires extensive sea space so that individual training and testing activities can occur at sufficient distances so they do not interfere with one another. Some training and testing activities require continuous access to large and unobstructed areas, consisting potentially of tens or thousands of square miles. This provides personnel the ability to develop competence and confidence in their capabilities across multiple types of weapons and sensors, and the ability to train to communicate and operate in a coordinated fashion as required during military missions and combat operations. For example, major training exercises using integrated warfare components may require large areas of the littorals, open ocean, and nearshore areas for realistic and safe anti-submarine warfare training. The Navy also requires large areas of sea space because it trains in a manner to avoid observation by potential adversaries. Modern sensing technologies make training on a large scale without observation more difficult. A foreign military's continual observation of U.S. Navy training in predictable geographic areas and timeframes would enable foreign nations to gather intelligence and subsequently develop techniques, tactics, and procedures to potentially and effectively counter U.S. naval operations. Other activities may be conducted on a smaller and more localized scale, with training or testing at discrete locations that are critical to certain aspects of military readiness.

The locations for training and testing activities are selected to maximize efficiency while supporting specific mission and safety requirements, deconflict sea space and airspace, and minimize the time personnel must spend away from home. Training and testing locations are typically selected based on their proximity to homeports, home bases, associated training ranges, testing facilities, air squadrons, and existing infrastructure (e.g., instrumented underwater ranges) to reduce travel time and associated costs. Activities involving the use of rotary-wing aircraft typically occur in proximity to shore or refueling stations due to fuel restrictions and safety requirements. Testing ranges are typically located near systems command support facilities, which provide critical infrastructure support and technical expertise necessary to conduct testing. Logistical support of range testing can only efficiently and effectively occur when the support is co-located with the testing activities. These same principles also apply to pierside and at-sea testing that must occur in proximity to naval shipyards and Navy contractor shipyards. Testing event site locations and associated field activities were originally established to support specific Navy mission testing needs using a selection process that included testing requirements, cost of living, availability of personnel, and low level of crowding from industry and development.

During its assessment to determine how and to what degree the implementation of mitigation would be compatible with meeting the purpose and need of the Proposed Action, the Navy considered mitigation measures to be practical to implement if they met all criteria discussed below:

- **Implementing the mitigation is safe:** Mitigation measures must not increase safety risks to Navy personnel and equipment, or to the public. When assessing whether implementing a mitigation measure would be safe, the Navy factored in the potential for increased pilot fatigue; accelerated fatigue-life of aircraft; typical fuel restrictions of participating aircraft; locations of refueling stations; proximity to aircraft emergency landing fields, critical medical facilities, and search and rescue capabilities; space restrictions of the observation platforms; the ability to de-conflict platforms and activities to ensure that training and testing activities do not impact each other; and the ability to avoid interaction with non-Navy sea space and airspace uses, such as established commercial air traffic routes, commercial vessel shipping lanes, and areas used for energy exploration or alternative energy development. Other safety considerations included identifying if mitigation measures would reasonably allow Lookouts to safely and effectively maintain situational awareness while observing the mitigation zones during typical activity conditions, or if the mitigation would increase the safety risk for personnel. For example, the safety risk would increase if Lookouts were required to direct their attention away from essential mission requirements.
- **Implementing the mitigation is sustainable:** One of the primary factors that the Navy incorporates into the planning and scheduling of its training and testing activities is the amount and type of available resources, such as funding, personnel, and equipment. Mitigation measures must be sustainable over the life of the Proposed Action, meaning that they will not require the use of resources in excess of what is available. When assessing whether implementing a mitigation measure would be sustainable, the Navy considered if the measure would require excessive time on station or time away from homeport for Navy personnel, require the use of additional personnel (i.e., manpower) or equipment (e.g., adding a small boat to serve as an additional observation platform), or result in additional operational costs (e.g., increased fuel consumption, equipment maintenance, or acquisition of new equipment).
- **Implementing the mitigation allows the Navy to continue meeting its mission requirements:** The Navy considered if each individual measure and the iterative and cumulative impact of all potential measures would be within the Navy's legal authority to implement. The Navy also considered if mitigation would modify training or testing activities in a way that would prevent individual activities from meeting their mission objectives and if mitigation would prevent the Navy from meeting its national security requirements or statutorily-mandated Title 10 requirements, such as by:
    - Impacting training and testing realism or preventing ready access to ranges, operating areas, facilities, or range support structures (which would reduce realism and present sea space and airspace conflicts).
    - Impacting the ability for Sailors to train and become proficient in using sensors and weapon systems as would be required in areas analogous to where the military operates or causing an erosion of capabilities or reduction in perishable skills (which would result in a significant risk to personnel or equipment safety during military missions and combat operations).

- o Impacting the ability for units to meet their individual training and certification requirements (which would impact the ability to deploy with the required level of readiness necessary to accomplish any tasking by Combatant Commanders).
- o Impacting the ability to certify forces to deploy to meet national security tasking (which would limit the flexibility of Combatant Commanders and warfighters to project power, engage in multi-national operations, and conduct the full range of naval warfighting capabilities in support of national security interests).
- o Impacting the ability of researchers, program managers, and weapons system acquisition programs to conduct accurate acoustic research to meet research objectives, effectively test systems and platforms (and components of these systems and platforms) before full-scale production or delivery to the fleet, or complete shipboard maintenance, repairs, or pierside testing prior to at-sea operations (which would not allow the Navy to ensure safety, functionality, and accuracy in military mission and combat conditions per required acquisition milestones or on an as-needed basis to meet operational requirements).
- o Requiring the Navy to provide advance notification of specific times and locations of Navy platforms, such as platforms using active sonar (which would present national security concerns).
- o Reducing the Navy's ability to be ready, maintain deployment schedules, or respond to national emergencies or emerging national security challenges (which would present national security concerns).

5.2.3.2 Factors Affecting Practicality

Two of the factors that influenced whether procedural mitigation measures met the practicality criteria were the number of times mitigation measures would likely be implemented and the duration over which the activity would likely be ceased. The number of times mitigation would likely be implemented is largely dependent on the size of the mitigation zone. As a mitigation zone size increases, the area of observation increases by an order of magnitude. This is because mitigation zones are measured as the radius (r) from a stressor but apply to circular area (A) around that stressor ($A = \pi * r^2$, where π is a constant that is approximately equal to 3.14). For example, a 100-yard (yd.) mitigation zone is equivalent to an area of 31,416 square yd. A 200-yd. mitigation zone is equivalent to an area of 125,664 square yd. Therefore, increasing a mitigation zone from 100 yd. to 200 yd. (i.e., doubling the mitigation zone radius) would quadruple the mitigation zone area (the area over which mitigation must be implemented). Similarly, increasing a mitigation zone from 1,000 yd. to 4,000 yd. (i.e., quadrupling the mitigation zone radius) would increase the mitigation zone area by a factor of 16. Increasing the area over which mitigation must be implemented consequently increases the number of times mitigation would likely be implemented during that activity.

The duration over which mitigation is implemented can differ considerably depending on the mitigation zone size, number of animal sightings, behavioral state of animals sighted (e.g., travelling at a fast pace on course to exit the mitigation zone, milling slowly in the center of the mitigation zone), and which pre-activity commencement or during-activity recommencement condition is met before the activity can commence or resume after each sighting. The duration of mitigation implementation typically equates to the amount of time the training or testing activity will be extended. The impact that extending the length of an activity has on safety, sustainability, and the Navy's ability to accomplish the activity's intended objectives varies by activity. This is one reason why the Navy tailors its mitigation zone sizes and mitigation requirements by activity category or stressor and the platforms involved.

As described in Section 5.2.1 (Procedural Mitigation Development), the Navy will mitigate for each applicable sighting and will continue mitigating until one of five conditions has been met. In some instances, such as if an animal dives underwater after a sighting, it may not be possible for a Lookout to visually verify if the animal has exited the mitigation zone. The Navy cannot delay or cease activities indefinitely for the purpose of mitigation due to impacts on safety, sustainability, and the Navy's ability to continue meeting its mission requirements. To account for this, one of the pre-activity commencement and during-activity recommencement conditions is an established post-sighting wait period of 30 minutes (min.) or 10 min., based on the platforms involved. Wait periods are designed to allow animals the maximum amount of time practical to resurface (i.e., become available to be observed by a Lookout) before activities resume. When developing the length of its wait periods, the Navy factored in the assumption that mitigation may need to be implemented more than once. For example, an activity may need to be delayed or ceased for more than one 30-min. or 10-min. period. Information on diving behaviors of marine mammals and sea turtles is presented in the U.S. Department of the Navy (2017c) technical report titled *Dive Distribution and Group Size Parameters for Marine Species Occurring in the U.S. Navy's Atlantic and Hawaii-Southern California Training and Testing Study Areas*.

The Navy assigns a 30-min. wait period to activities conducted from vessels and activities that involve aircraft that are not typically fuel constrained (e.g., maritime patrol aircraft). A 30-min. period covers the average dive times of most marine mammals and a portion of the dive times of sea turtles and deep-diving marine mammals (i.e., sperm whales, dwarf and pygmy sperm whales [Kogia whales], and beaked whales). The Navy determined that a 30-min. wait period is the maximum wait time that is practical to implement during activities involving vessels and aircraft that are not typically fuel constrained to allow the activities to continue meeting their intended objectives. For example, the typical duration of Maritime Security Operations – Anti-Swimmer Grenades (which involve the use of small boats) is 1 hour. These activities are scheduled to occur at specific locations within specific timeframes based on range scheduling and for sea space deconfliction. Implementing one wait period would result in the activity being extended by half of the typical activity duration. The Navy determined that, given the benefit of this mitigation, a 30-min. wait period would be practical to implement for this activity; however, implementing a longer wait period (such as extending the wait period to 45 min. or 60 min. to cover the average dive times of sea turtles and additional marine mammal species) would be impractical. Increasing the wait period, and consequently the amount of time the activity would need to be delayed or extended in order to accomplish its intended objective, would impact activity realism or cause sea space conflicts in a way that could impact the Navy's ability to continue meeting its mission requirements. For example, delaying an activity for multiple wait periods could result in personnel not being able to detonate an explosive before the participating platforms are required to depart the range due to range scheduling; therefore, the activity would not accomplish its intended objectives.

The Navy assigns a 10-min. wait period to activities involving aircraft that are typically fuel constrained (e.g., rotary-wing aircraft, fighter aircraft). A 10-min. period covers a portion, but not the average, dive times of marine mammals and sea turtles. The Navy determined that a 10-min. wait period is the maximum wait time that is practical to implement during activities involving aircraft that are typically fuel constrained. Increasing the wait period, and consequently the amount of time the training or testing activity would need to be extended in order to accomplish its intended objective, would require aircraft to depart the activity area to refuel in order to safely complete the event. If the wait period was implemented multiple times, the aircraft would be required to depart the activity area to refuel multiple times. Refueling events would vary in duration, depending on the activity location and proximity to the nearest refueling station. Multiple refueling events would generally be expected to extend the length of the activity by two to five times or more. This would impact activity realism, could cause air space or sea space conflicts in a way that could impact the Navy's ability to continue meeting its mission requirements, would decrease the ability for Lookouts to safely and effectively maintain situational awareness of the activity area, and would increase safety risks due to increased pilot fatigue and accelerated fatigue-life of aircraft. For example, delaying a Kilo Dip activity for multiple wait periods could result in personnel not being able to conduct a functional check of the dipping sonar system before the rotary-wing aircraft is required to depart the range due to range scheduling; therefore, the activity would not accomplish its intended objectives.

Factors that influenced whether a mitigation area measure met the practicality criteria included the historical use and projected future use of geographic locations for training and testing activities under the Proposed Action, and the relative importance of each location. The frequency that an area is used for training or testing does not necessarily equate to that area's level of importance for meeting an individual activity objective, or collectively, the Navy's mission requirements. While frequently used areas can be essential to one or more types of military readiness activities, some infrequently used areas are critical for a particular training exercise, testing mission, or research project.

5.3 Procedural Mitigation to be Implemented

The first procedural mitigation measure (Section 5.3.1, Environmental Awareness and Education) is designed to aid Lookouts and other personnel with observation, environmental compliance, and reporting responsibilities. The remaining procedural mitigation measures are organized by stressor type and training or testing activity category.

5.3.1 Environmental Awareness and Education

The Navy will continue to implement procedural mitigation to provide environmental awareness and education to the appropriate personnel to aid visual observation, environmental compliance, and reporting responsibilities, as outlined in Table 5.3-1.

The Navy requires Lookouts and other personnel to complete their assigned environmental compliance responsibilities (e.g., mitigation, reporting requirements) before, during, and after training and testing activities. Marine Species Awareness Training was first developed in 2007 and has since undergone numerous updates to ensure that the content remains current. The most recent product was approved by NMFS and released by the Navy in 2014. In 2014, the Navy developed a series of educational training modules, known as the Afloat Environmental Compliance Training program, to ensure Navywide compliance with environmental requirements. The Afloat Environmental Compliance Training program, including the updated Marine Species Awareness Training, helps Navy personnel from the most junior Sailors to Commanding Officers gain a better understanding of their personal environmental compliance roles and responsibilities. Additional information on the Protective Measures Assessment Protocol is provided in Section 5.1.2.1 (Protective Measures Assessment Protocol), and additional information on training and testing activity and incident reports is provided in Section 5.1.2.2 (Monitoring, Research, and Reporting Initiatives).

From an operational perspective, the interactive web-based format of the U.S. Navy Afloat Environmental Compliance Training Series is ideal for providing engaging and educational content that is cost effective and convenient to access by personnel who oftentimes face rotating job assignments. The U.S. Navy Afloat Environmental Compliance Training Series has resulted in an improvement in the quality and accuracy of training and testing activity reports, incident reports, and Sonar Positional Reporting System reports submitted by Navy operators. Improved reporting quality indicates that the U.S. Navy Afloat Environmental Compliance Training Series is helping to facilitate Navywide environmental compliance as intended.

Table 5.3-1: Environmental Awareness and Education

Procedural Mitigation Description
Stressor or Activity • All training and testing activities, as applicable
Resource Protection Focus • Marine mammals • Sea turtles
Mitigation Requirements • Appropriate personnel (including civilian personnel) involved in mitigation and training or testing activity reporting under the Proposed Action will complete one or more modules of the U.S. Navy Afloat Environmental Compliance Training Series, as identified in their career path training plan. Modules include: – **Introduction to the U.S. Navy Afloat Environmental Compliance Training Series.** The introductory module provides information on environmental laws (e.g., ESA, MMPA) and the corresponding responsibilities that are relevant to Navy training and testing activities. The material explains why environmental compliance is important in supporting the Navy's commitment to environmental stewardship. – **Marine Species Awareness Training.** All bridge watch personnel, Commanding Officers, Executive Officers, maritime patrol aircraft aircrews, anti-submarine warfare and mine warfare rotary-wing aircrews, Lookouts, and equivalent civilian personnel must successfully complete the Marine Species Awareness Training prior to standing watch or serving as a Lookout. The Marine Species Awareness Training provides information on sighting cues, visual observation tools and techniques, and sighting notification procedures. Navy biologists developed Marine Species Awareness Training to improve the effectiveness of visual observations for biological resources, focusing on marine mammals and sea turtles, and including floating vegetation, jellyfish aggregations, and flocks of seabirds. – **U.S. Navy Protective Measures Assessment Protocol.** This module provides the necessary instruction for accessing mitigation requirements during the event planning phase using the Protective Measures Assessment Protocol software tool. – **U.S. Navy Sonar Positional Reporting System and Marine Mammal Incident Reporting.** This module provides instruction on the procedures and activity reporting requirements for the Sonar Positional Reporting System and marine mammal incident reporting.

Lookouts and members of the operational community have demonstrated enhanced knowledge and understanding of the Navy's environmental compliance responsibilities since the development of the U.S. Navy Afloat Environmental Compliance Training Series. From January 2007 through August 2018, the Navy reported four whale strikes during Navy activities in the Study Area (an average of 0.34 per year), with the last strike occurring in 2012. For the 10-year period (1997–2006) prior to the implementation of the original Marine Species Awareness Training in 2007, the Navy reported 15 whale strikes during Navy activities in the Study Area (an average of 1.5 per year). This is more than three times the amount reported for January 2007 through August 2018. It is likely that the implementation of the Marine Species Awareness Training starting in 2007, and the additional U.S. Navy Afloat Environmental Compliance Training Series modules starting in 2014, has contributed to this reduction in marine mammal strikes. This indicates that the environmental awareness and education program is helping to improve the effectiveness of mitigation implementation. A more detailed analysis of marine mammal vessel strikes is presented in Section 3.7.3.4.1 (Impacts from Vessels and In-Water Devices).

5.3.2 Acoustic Stressors

The Navy will implement procedural mitigation to avoid or reduce potential impacts on biological resources from the acoustic stressors or activities discussed in the sections below.

5.3.2.1 Active Sonar

The Navy will continue to implement procedural mitigation to avoid or reduce potential impacts on marine mammals and sea turtles from active sonar, as outlined in Table 5.3-2. In addition to procedural mitigation, the Navy will implement mitigation for the use of active sonar within mitigation areas (see Section 5.4.2, Mitigation Areas off the Northeastern United States; Section 5.4.3, Mitigation Areas off the Mid-Atlantic and Southeastern United States; and Section 5.4.4, Mitigation Areas in the Gulf of Mexico).

Table 5.3-2: Procedural Mitigation for Active Sonar

Procedural Mitigation Description
<u>Stressor or Activity</u> • Low-frequency active sonar, mid-frequency active sonar, high-frequency active sonar – For vessel-based activities, mitigation applies only to sources that are positively controlled and deployed from manned surface vessels (e.g., sonar sources towed from manned surface platforms). – For aircraft-based activities, mitigation applies only to sources that are positively controlled and deployed from manned aircraft that do not operate at high altitudes (e.g., rotary-wing aircraft). Mitigation does not apply to active sonar sources deployed from unmanned aircraft or aircraft operating at high altitudes (e.g., maritime patrol aircraft).
<u>Resource Protection Focus</u> • Marine mammals • Sea turtles (only for sources <2 kilohertz [kHz])
<u>Number of Lookouts and Observation Platform</u> • Hull-mounted sources: – 1 Lookout: Platforms with space or manning restrictions while underway (at the forward part of a small boat or ship) and platforms using active sonar while moored or at anchor (including pierside) – 2 Lookouts: Platforms without space or manning restrictions while underway (at the forward part of the ship) – 4 Lookouts: Pierside sonar testing activities at Port Canaveral, Florida and Kings Bay, Georgia • Sources that are not hull-mounted: – 1 Lookout on the ship or aircraft conducting the activity
<u>Mitigation Requirements</u> • Mitigation zones: – 1,000 yd. power down, 500 yd. power down, and 200 yd. shut down for low-frequency active sonar ≥200 decibels (dB) and hull-mounted mid-frequency active sonar – 200 yd. shut down for low-frequency active sonar <200 dB, mid-frequency active sonar sources that are not hull-mounted, and high-frequency active sonar • Prior to the initial start of the activity (e.g., when maneuvering on station): – Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear. – Observe the mitigation zone for marine mammals and sea turtles; if observed, relocate or delay the start of active sonar transmission. • During the activity: – Low-frequency active sonar ≥200 decibels (dB) and hull-mounted mid-frequency active sonar: Observe the mitigation zone for marine mammals and sea turtles (for sources <2 kHz); power down active sonar transmission by 6 dB if observed within 1,000 yd. of the sonar source; power down an additional 4 dB (10 dB total) within 500 yd.; cease transmission within 200 yd. – Low-frequency active sonar <200 dB, mid-frequency active sonar sources that are not hull-mounted, and high-frequency active sonar: Observe the mitigation zone for marine mammals and sea turtles (for sources <2 kHz); cease active sonar transmission if observed within 200 yd. of the sonar source. • Commencement/recommencement conditions after a marine mammal or sea turtle sighting before or during the activity: – The Navy will allow a sighted marine mammal or sea turtle to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing or powering up active sonar transmission) until one of the following conditions has been met: (1) the animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the sonar source; (3) the mitigation zone has been clear from any additional sightings for 10 min. for aircraft-deployed sonar sources or 30 min. for vessel-deployed sonar sources; (4) for mobile activities, the active sonar source has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting; or (5) for activities using hull-mounted sonar, the ship concludes that dolphins are deliberately closing in on the ship to ride the ship's bow wave, and are therefore out of the main transmission axis of the sonar (and there are no other marine mammal sightings within the mitigation zone).

Table 5.3-2: Procedural Mitigation for Active Sonar (continued)

Procedural Mitigation Description
• Additional requirements: – At Port Canaveral, Florida and Kings Bay, Georgia the Navy will equip Lookouts with polarized sunglasses and conduct active sonar activities during daylight hours to ensure adequate sightability of manatees and sea turtles. The Navy will notify the Port Authority prior to commencing pierside sonar testing at these locations. The Navy will observe the mitigation zone for marine mammals and sea turtles for 30 min. after completion of pierside sonar testing at these locations. – The Navy will reduce mid-frequency active sonar transmissions at Kings Bay, Georgia by at least 36 dB from full power. The Navy will communicate sightings of manatees and sea turtles (e.g., time, location, count, animal size, description of research tags if present, direction of travel) made during or after pierside sonar testing at Kings Bay, Georgia to the Georgia Department of Natural Resources sightings hotline, Base Natural Resources Manager, and Port Operations. Port Operations will disseminate sightings information to other vessels operating in the vicinity and will keep logs of all manatee sightings.

In Phase II, the Navy's active sonar mitigation zones were based on associated average ranges to PTS. When developing Phase III mitigation, the Navy analyzed the potential for increasing the sizes of these mitigation zones. The Navy determined that the current mitigation zones for active sonar are the largest areas within which it is practical to implement mitigation; therefore, it will continue implementing these same mitigation zones for Phase III. The Navy is clarifying that the mitigation zone for low-frequency active sonar sources at or above 200 dB will be the same as the mitigation implemented for hull-mounted mid-frequency active sonar; whereas low-frequency active sonar sources below 200 dB will implement the same mitigation zone as high-frequency active sonar and mid-frequency active sonar sources that are not hull-mounted. The Navy is also clarifying that it will require observation of the mitigation zone prior to the initial start of the activity to ensure the area is clear of applicable biological resources. The Navy has always verified that the mitigation zone is visually clear prior to conducting active sonar activities and is more clearly capturing this current practice in the mitigation measures for Phase III. The Navy will follow the incident reporting procedures outlined in Section 5.1.2.2.3 (Incident Reports) if an incident is detected at any time during the event.

The mitigation zone sizes and proximity to the observation platforms will result in a high likelihood that Lookouts will be able to detect marine mammals and sea turtles throughout the mitigation zones. Observing for indicators of marine mammal and sea turtle presence will further help avoid or reduce potential impacts on these resources within the mitigation zones. The mitigation specific to Port Canaveral, Florida and Kings Bay, Georgia will provide additional protection for sea turtles and manatees during pierside testing at these locations. The mitigation to conduct pierside sonar activities during daylight hours will help increase the likelihood that Lookouts will detect manatees and sea turtles. The Navy is able to implement a 36-dB reduction from full power for mid-frequency active sonar transmissions at Kings Bay; however, this same mitigation is not practical to implement elsewhere due to the type of submarines and sonar systems used during testing activities at other pierside locations (e.g., Port Canaveral).

Section 3.7.3.1.2 (Impacts from Sonar and Other Transducers) provides a full analysis of the potential impacts of sonar on marine mammals and includes the predicted impact ranges for various source bins. For low-frequency active sonar at 200 dB or more and hull-mounted mid-frequency active sonar, bin MF1 has the longest predicted ranges to PTS. For the highest source level in bin MF1, the 1,000-yd. and 500-yd. power down mitigation zones extend beyond the average ranges to PTS for marine mammals. The 200-yd. shut down mitigation zone extends beyond the average ranges to PTS for all marine mammal hearing groups except high-frequency cetaceans (the mitigation zone extends into a portion of the average range to PTS for this hearing group). The ranges to PTS for the 200-yd. shut down mitigation zone were calculated based on full power transmissions and do not consider that the impact ranges would be reduced if the 1,000-yd. and 500-yd. power down mitigation measures are implemented in response to a marine mammal sighting in those mitigation zones. If an animal is first sighted in the 1,000-yd. or 500-yd. power down mitigation zone, the source level reduction would shorten the ranges to PTS, and the 200-yd. shut down mitigation would then extend beyond the average ranges to PTS for all hearing groups. For low-frequency active sonar below 200 dB, mid-frequency active sonar sources that are not hull-mounted, and high-frequency active sonar, bin HF4 has the longest predicted ranges to PTS. For the highest source level in bin HF4, the 200-yd. shut down mitigation zone extends beyond the average ranges to PTS for marine mammals. The mitigation zones for active sonar will help avoid or reduce the potential for exposure to PTS for marine mammals.

The active sonar mitigation zones also extend into a portion of the average ranges to TTS for marine mammals; therefore, mitigation will help avoid or reduce the potential for some exposure to higher levels of TTS. Active sonar sources that fall within lower source bins or are used at lower source levels have shorter impact ranges than those discussed above; therefore, the mitigation zones will extend further beyond or into the average ranges to PTS and TTS for these sources. The analysis in Section 3.7.3.1.2 (Impacts from Sonar and Other Transducers) indicates that pygmy and dwarf sperm whales (Kogia whales) are the only deep-diving marine mammal species that could potentially experience PTS impacts from active sonar in the Study Area. The 30-min. wait period for vessel-deployed sources will cover the average dive times of marine mammal species that could experience PTS from sonar in the mitigation zone, except for Kogia whales. The 10-min. wait period for aircraft-deployed sources will cover a portion, but not the average, dive times of marine mammals.

Section 3.8.3.1.2 (Impacts from Sonar and Other Transducers) provides a full analysis of the potential impacts of sonar on sea turtles. Due to sea turtle hearing capabilities, the mitigation only applies to sea turtles during the use of sources below 2 kHz. The range to auditory effects for most active sonar sources in sea turtle hearing range (e.g., LF5) is zero meters. Impact ranges are longer (i.e., up to tens of meters) for active sonars with higher source levels. The mitigation zones for active sonar extend beyond the ranges to PTS and TTS for sea turtles; therefore, mitigation will help avoid or reduce the potential for exposure to these effects for sea turtles.

As described previously, the Phase III mitigation zones are based on the largest areas within which it is practical for the Navy to implement mitigation during training and testing. Training and testing with active sonar is essential to national security. Active sonar is the only reliable technology for detecting and tracking potential enemy diesel-electric submarines that could be operating covertly in coastal waters of the United States or its allies. For example, small diesel-electric submarines operate quietly and may hide in shallow coastal and littoral waters. The ability to effectively operate active sonar is a highly perishable skill that must be repeatedly practiced during realistic training. Naval forces must train in the same mode and manner in which they conduct military missions and combat operations. Anti-submarine warfare training typically involves the periodic use of active sonar to develop the "tactical picture," or an understanding of the battle space (e.g., area searched or unsearched, identifying false contacts, and understanding the water conditions). This can take from several hours to multiple days and typically occurs over vast areas with varying physical and oceanographic conditions (e.g., bathymetry, topography, surface fronts, and variations in sea surface temperature). Sonar operators train to avoid or reduce interference and sound-reducing clutter from varying ocean floor topographies and environmental conditions, practice coordinating their efforts with other sonar operators in a strike group, develop skill proficiency in detecting and tracking submarines and other threats, and practice the focused endurance vital to effectively working as a team in shifts around the clock until the conclusion of the event.

Increasing the mitigation zone sizes would result in a larger area over which active sonar would need to be powered down or shut down in response to a sighting, and therefore would likely increase the number of times that these mitigation measures would be implemented. This would extend the length of the activity, significantly diminish event realism, and prevent activities from meeting their intended objectives. It would also create fundamental differences between how active sonar would be used in training and how active sonar should be used during military missions and combat operations. For example, additional active sonar power downs or shut downs would prevent sonar operators from developing and maintaining awareness of the tactical picture during training events. Without realistic training in conditions analogous to military missions and combat operations, sonar operators cannot become proficient in effectively operating active sonar. Sonar operators, vessel crews, and aircrews would be expected to operate active sonar during military missions and combat operations in a manner inconsistent with how they were trained.

During integrated training, multiple vessels and aircraft may participate in an exercise using different warfare components simultaneously. Degrading the value of one training element results in a degradation of the training value of the other training elements. Degrading the value of training would cause a reduction in perishable skills and diminished operational capability, which would significantly impact military readiness. Each of these factors would ultimately impact the ability for units to meet their individual training and certification requirements and the Navy's ability to certify forces to safely deploy to meet national security tasking. Diminishing proficiency or eroding active sonar capabilities would present a significant risk to personnel safety during military missions and combat operations and would impact the ability to deploy with the required level of readiness necessary to accomplish any tasking by Combatant Commanders.

Increasing the number of times that the Navy must power down or shut down active sonar transmissions during testing activities would result in similar consequences to activity realism. For example, at-sea sonar testing activities are required in order to calibrate or document the functionality of sonar and torpedo systems while a ship or submarine is in an open ocean environment. Additional powering down or shutting down active sonar transmissions would prevent this activity from meeting its intended objective, such as verifying if the ship meets design acoustic specifications. These types of impacts would impede the ability of researchers, program managers, and weapons system acquisition programs to meet research objectives and testing requirements per required acquisition milestones or on an as-needed basis to meet operational requirements, and would impede shipboard maintenance, repairs, or pierside testing prior to at-sea operations.

For activities that involve aircraft (e.g., activities involving rotary-wing aircraft that use dipping sonar or sonobuoys to locate submarines or submarine targets), extending the length of the activity would require aircraft to depart the area to refuel. If multiple refueling events were required, the length of the activity would be extended by two to five times or more, which would decrease the ability for Lookouts to safely and effectively maintain situational awareness of the activity area and increase safety risks due to increased pilot fatigue and accelerated fatigue-life of aircraft. Extending the length of the activity would also result in additional operational costs due to increased fuel consumption. Increasing the mitigation zone sizes would not result in a substantial reduction of injurious impacts because, as described above, the mitigation zones extend beyond the average ranges to PTS for sea turtles and marine mammals.

In summary, the operational community determined that implementing procedural mitigation for active sonar beyond what is detailed in Table 5.3-2 would be incompatible with the practicality assessment criteria for safety, sustainability, and mission requirements.

5.3.2.2 Air Guns

The Navy developed new procedural mitigation for Phase III to avoid or reduce potential impacts on marine mammals and sea turtles from air guns, as outlined in Table 5.3-3. The Navy developed the new mitigation zone based on the largest area within which it is practical to implement mitigation for air gun activities. The Navy will implement procedural mitigation measures for this activity that are consistent with procedural mitigation for other acoustic stressors. For example, the Navy will require observations of the mitigation zone prior to the initial start of the activity to ensure the area is clear of applicable biological resources. The Navy will follow the incident reporting procedures outlined in Section 5.1.2.2.3 (Incident Reports) if an incident is detected at any time during the event. The small mitigation zone size and proximity to the observation platform will result in a high likelihood that Lookouts will be able to detect marine mammals and sea turtles throughout the mitigation zone. Observing for indicators of marine mammal and sea turtle presence will further help avoid or reduce potential impacts on these resources within the mitigation zone.

Table 5.3-3: Procedural Mitigation for Air Guns

Procedural Mitigation Description
Stressor or Activity • Air guns
Resource Protection Focus • Marine mammals • Sea turtles
Number of Lookouts and Observation Platform • 1 Lookout positioned on a ship or pierside
Mitigation Requirements • Mitigation zone: – 150 yd. around the air gun • Prior to the initial start of the activity (e.g., when maneuvering on station): – Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear. – Observe the mitigation zone for marine mammals and sea turtles; if observed, relocate or delay the start of air gun use. • During the activity: – Observe the mitigation zone for marine mammals and sea turtles; if observed, cease air gun use. • Commencement/recommencement conditions after a marine mammal or sea turtle sighting before or during the activity: – The Navy will allow a sighted marine mammal or sea turtle to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing air gun use) until one of the following conditions has been met: (1) the animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the air gun; (3) the mitigation zone has been clear from any additional sightings for 30 min.; or (4) for mobile activities, the air gun has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

Section 3.7.3.1.3 (Impacts from Air Guns) and Section 3.8.3.1.3 (Impacts from Air Guns) provide a full analysis of the potential impacts of air guns on marine mammals and sea turtles, respectively, including the air gun impact ranges for the maximum number of pulses expected for air gun activities in the Study Area, which is 100 pulses. For 100 pulses, the mitigation zone extends beyond the average ranges to PTS for sea turtles and all marine mammal hearing groups. Therefore, mitigation will help avoid or reduce the potential for exposure to PTS.

The air gun mitigation zone also extends beyond the average ranges to TTS for sea turtles, high-frequency cetaceans, mid-frequency cetaceans, and phocids; and into a portion of the average ranges to TTS for low-frequency cetaceans. Therefore, depending on the hearing group, mitigation will help avoid or reduce the potential for exposure to all or a portion of TTS. Air gun activities using 10 pulses or 1 pulse have shorter impact ranges those using 100 pulses. The mitigation zone extends beyond the average ranges to PTS and TTS for sea turtles and marine mammals for 10 pulses and 1 pulse. The 30-min. wait period will cover the average dive times of the marine mammal species that could be present in the mitigation zone.

When developing the new mitigation, the Navy analyzed a range of potential mitigation zone sizes. A larger mitigation zone would result in a larger area over which air gun activities would need to be ceased in response to a sighting, and therefore would likely increase the number of times air guns would be ceased. However, establishing a larger mitigation zone would not result in a substantial reduction of injurious impacts because the mitigation zone extends beyond the average ranges to PTS for sea turtles and marine mammals.

Due to the nature of how air gun testing is conducted (e.g., generated impulses with short durations), increasing the size of the mitigation zone would extend the length of the activity and significantly diminish realism in a way that would prevent the activity from meeting its intended objectives. For example, during semi-stationary equipment testing, the Navy determines the functionality of air gun equipment and test sensors and system performance. These tests must be conducted in the same manner and under the same conditions in which they will be conducted during military readiness training exercises, military missions, and combat operations. Extending the length of the activity would decrease realism, increase time at sea for vessels, and increase fuel usage, particularly when air guns are deployed from small boats or small research vessels. Therefore, additional mitigation would prevent the Navy from validating whether air guns perform as expected; determining whether they are operationally effective, suitable, survivable, and safe for their intended uses by the fleet; from meeting research program objectives; and from meeting testing requirements per required acquisition milestones or on an as-needed basis to meet operational requirements.

In summary, the operational community determined that implementing procedural mitigation beyond what is detailed in Table 5.3-3 would be incompatible with the practicality assessment criteria for safety, sustainability, and mission requirements.

5.3.2.3 Pile Driving

The Navy is incorporating mitigation from the 2015 Environmental Assessment for Joint Logistics Over-the-Shore Training at Joint Expeditionary Base Little Creek-Fort Story, Virginia Beach, Virginia and Marine Corps Base Camp Lejeune, Jacksonville, North Carolina to avoid or reduce potential impacts on marine mammals and sea turtles from pile driving, as outlined in Table 5.3-4. In the 2015 Environmental Assessment for Joint Logistics Over-the-Shore Training at Joint Expeditionary Base Little Creek-Fort Story, Virginia Beach, Virginia and Marine Corps Base Camp Lejeune, Jacksonville, North Carolina, the pile driving mitigation zone was based on the associated average ranges to PTS. When developing Phase III mitigation, the Navy analyzed the potential for increasing the size of the mitigation zone. The Navy identified an opportunity to increase the mitigation zone size for pile driving by 40 yd. to enhance protections to the maximum extent practicable. This increase is reflected in Table 5.3-4. The mitigation zone for pile driving is now based on the largest area within which it is practical to implement mitigation.

Table 5.3-4: Procedural Mitigation for Pile Driving

Procedural Mitigation Description
Stressor or Activity • Pile driving and pile extraction sound during Elevated Causeway System training
Resource Protection Focus • Marine mammals • Sea turtles
Number of Lookouts and Observation Platform • 1 Lookout positioned on the shore, the elevated causeway, or a small boat
Mitigation Requirements • Mitigation zone: – 100 yd. around the pile • Prior to the initial start of the activity (for 30 min.): – Observe the mitigation zone for floating vegetation; if observed, delay the start until the mitigation zone is clear. – Observe the mitigation zone for marine mammals and sea turtles; if observed, delay the start of pile driving or vibratory pile extraction. • During the activity: – Observe the mitigation zone for marine mammals and sea turtles; if observed, cease impact pile driving or vibratory pile extraction. – In the Navy Cherry Point Range Complex, the Navy will maintain a log detailing any sightings or injuries to manatees during pile driving. If a manatee was sighted during the activity, upon completion of the activity, the Navy project manager or civilian equivalent will prepare a report that summarizes all information on manatees encountered and submit the report to the USFWS, Raleigh Field Office. The Navy will report any injury of a manatee to the USFWS, NMFS, and the North Carolina Wildlife Resources Commission. • Commencement/recommencement conditions after a marine mammal or sea turtle sighting before or during the activity: – The Navy will allow a sighted marine mammal or sea turtle to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing pile driving or pile extraction) until one of the following conditions has been met: (1) the animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the pile driving location; or (3) the mitigation zone has been clear from any additional sightings for 30 min.

The Navy is clarifying that it will require observation of the mitigation zone prior to the initial start of the activity to ensure the area is clear of applicable biological resources. The Navy has always verified that the mitigation zone is visually clear prior to conducting pile driving activities and is more clearly capturing this current practice in the mitigation measures for Phase III. The Navy will follow the incident reporting procedures outlined in Section 5.1.2.2.3 (Incident Reports) if an incident is detected at any time during the event.

The small mitigation zone size and proximity to the observation platform will result in a high likelihood that Lookouts will be able to detect marine mammals and sea turtles throughout the mitigation zone. Observing for indicators of marine mammal and sea turtle presence will further help avoid or reduce potential impacts on these resources within the mitigation zone. The additional mitigation in the Navy Cherry Point Range Complex will help facilitate a better understanding of manatee presence and potential impacts from pile driving at this location.

Section 3.7.3.1.4 (Impacts from Pile Driving) and Section 3.8.3.1.4 (Impacts from Pile Driving) provide a full analysis of the potential impacts of pile driving on marine mammals and sea turtles, respectively, and include the approximate impact ranges for impact pile driving and vibratory pile extraction. The ranges to effect from impact pile driving are longer than the ranges to effect for vibratory pile extraction. For impact pile driving, the 100 yd. mitigation zone extends beyond the average ranges to PTS for sea turtles and marine mammals. Therefore, mitigation will help avoid or reduce the potential for exposure to PTS. The mitigation zone also extends beyond the average range to TTS for impact pile driving for sea turtles and mid-frequency cetaceans, and into a portion of the average range to TTS for low-frequency cetaceans, high-frequency cetaceans, and phocids. Therefore, depending on the hearing group, mitigation will help avoid or reduce the potential for exposure to all or a portion of TTS. Vibratory pile extraction has shorter predicted impact ranges than impact pile driving. The mitigation zone will extend further beyond the average ranges to PTS, and further beyond (or into, depending on hearing group) the average ranges to TTS during vibratory pile driving. The 30-min. wait period will cover the average dive times of the marine mammal species that could be present in the mitigation zone.

As described previously, the Phase III mitigation zone is based on the largest area within which it is practical for the Navy to implement mitigation for this activity. Increasing the mitigation zone would result in a larger area over which pile driving would need to be ceased in response to a sighting, and therefore would likely increase the number of times pile driving is ceased during Elevated Causeway System training. However, increasing the mitigation zone would not result in a substantial reduction of injurious impacts because the mitigation zone extends beyond the average ranges to PTS for sea turtles and marine mammals. The Navy also analyzed the potential for implementing additional types of mitigation employed by commercial construction projects, such as the use of bubble curtains and other sound attenuation devices. The Navy determined that these mitigation techniques would be impractical to use during Elevated Causeway System training due to impacts on event realism. The use of additional mitigation techniques would create fundamental differences between how pile driving would be conducted during training and how pile driving should be conducted during military missions and combat operations. This would present a significant risk to personnel safety during military missions and combat operations.

Elevated Causeway System training involves multiple steps, including driving support pilings into the sand, securing causeway platforms onto the piles, assembling causeway platforms into a pier, and removing the pier and piles. The activity provides essential training for each component individually and for the logistical coordination of all components as a whole. In order for the Navy to effectively conduct this training exercise, all components must be completed on time and as they would during military missions and combat operations. Increasing the number of times that the Navy must cease pile driving would result in schedule delays to the first component of Elevated Causeway System training (i.e., installation of support pilings), which would diminish realism, put the activity timeline at risk, and impact the Navy's ability to become proficient in each component individually and the logistical coordination of the activity as a whole. These factors would prevent the activity from meeting its intended objective.

In summary, the operational community determined that implementing procedural mitigation beyond what is detailed in Table 5.3-4 would be incompatible with the practicality assessment criteria for safety and mission requirements.

5.3.2.4 Weapons Firing Noise

The Navy will continue to implement procedural mitigation to avoid or reduce potential impacts on marine mammals and sea turtles from weapons firing noise, as outlined in Table 5.3-5. In Phase II, the weapons firing noise mitigation zone was based on the associated average ranges to PTS. When developing Phase III mitigation, the Navy analyzed the potential for increasing the size of the mitigation zone. The Navy determined that the current mitigation zone is the largest area within which it is practical to implement mitigation for this activity; therefore, it will continue implementing this same mitigation zone for Phase III.

The Navy is clarifying that it will require observation of the mitigation zone prior to the initial start of the activity to ensure the area is clear of applicable biological resources. The Navy has always verified that the mitigation zone is visually clear prior to conducting weapons firing activities and is more clearly capturing this current practice in the mitigation measures for Phase III. The Navy will follow the incident reporting procedures outlined in Section 5.1.2.2.3 (Incident Reports) if an incident is detected at any time during the event.

Table 5.3-5: Procedural Mitigation for Weapons Firing Noise

Procedural Mitigation Description
Stressor or Activity • Weapons firing noise associated with large-caliber gunnery activities
Resource Protection Focus • Marine mammals • Sea turtles
Number of Lookouts and Observation Platform • 1 Lookout positioned on the ship conducting the firing – Depending on the activity, the Lookout could be the same one described in Section 5.3.3.3 (Explosive Medium-Caliber and Large-Caliber Projectiles) or Section 5.3.4.3 (Small-, Medium-, and Large-Caliber Non-Explosive Practice Munitions).
Mitigation Requirements • Mitigation zone: – 30° on either side of the firing line out to 70 yd. from the muzzle of the weapon being fired • Prior to the initial start of the activity: – Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear. – Observe the mitigation zone for marine mammals and sea turtles; if observed, relocate or delay the start of weapons firing. • During the activity: – Observe the mitigation zone for marine mammals and sea turtles; if observed, cease weapons firing. • Commencement/recommencement conditions after a marine mammal or sea turtle sighting before or during the activity: – The Navy will allow a sighted marine mammal or sea turtle to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing weapons firing) until one of the following conditions has been met: (1) the animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the firing ship; (3) the mitigation zone has been clear from any additional sightings for 30 min.; or (4) for mobile activities, the firing ship has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

The small mitigation zone size and proximity to the observation platform will result in a high likelihood that Lookouts will be able to detect marine mammals and sea turtles throughout the mitigation zone. Observing for indicators of marine mammal and sea turtle presence will further help avoid or reduce potential impacts on these resources within the mitigation zone.

Section 3.7.3.1.7 (Impacts from Weapons Noise) and Section 3.8.3.1.7 (Impacts from Weapons Noise) provide a full analysis of the potential impacts of weapons noise on marine mammals and sea turtles, respectively. As described in Section 3.0.3.3.1.6 (Weapons Firing, Launch, and Inert Impact), underwater sounds would be strongest just below the surface and directly under the firing point. Any sound that enters the water only does so within a narrow cone below the firing point or path of the projectile. The mitigation zone extends beyond the distance to which marine mammals and sea turtles would likely experience PTS or TTS from weapons firing noise; therefore, mitigation will help avoid or reduce the potential for exposure to these impacts.

As described previously, the Phase III mitigation zone is based on the largest area within which it is practical for the Navy to implement mitigation for this activity. Increasing the mitigation zone would result in a larger area over which weapons firing would need to be ceased in response to a sighting, and therefore would likely increase the number of times weapons firing would be ceased. However, increasing the mitigation zone size would not result in a substantial reduction of injurious impacts because the mitigation zone extends beyond the average ranges to PTS for sea turtles and marine mammals.

Large-caliber gunnery training activities may involve a single ship firing or may be conducted as part of a larger exercise involving multiple ships. Surface ship crews learn to track targets (e.g., with radar), engage targets, practice defensive marksmanship, and coordinate their efforts within the context of larger activities. Increasing the number of times that the Navy must cease weapons firing during training would decrease realism and impact the ability for Navy Sailors to train and become proficient in using large-caliber guns as required during military missions and combat operations. For example, additional ceasing of the activity would reduce the crew's ability to react to changes in the tactical situation or response to an incoming threat, which could result in a delay to the ship's training schedule. When training is undertaken in the context of a coordinated exercise involving multiple ships, degrading the value of one of the training element results in a degradation of the training value of the other training elements. These factors would ultimately impact the ability for units to meet their individual training and certification requirements, and the Navy's ability to certify forces to deploy to meet national security tasking.

Increasing the number of times that the Navy must cease weapons firing during testing activities would result in similar consequences to activity realism, which would impede the ability of program managers and weapons system acquisition programs to meet testing requirements per required acquisition milestones or on an as-needed basis to meet operational requirements. This would impact the ability to effectively test large-caliber guns before full-scale production or delivery to the fleet to ensure functionality, safety, and accuracy in military mission and combat conditions.

In summary, the operational community determined that implementing procedural mitigation for weapons firing noise beyond what is detailed in Table 5.3-5 would be incompatible with the practicality assessment criteria for safety and mission requirements.

5.3.2.5 Aircraft Overflight Noise

The Navy will continue to implement procedural mitigation to avoid or reduce potential impacts on nesting birds and cultural resources from aircraft overflights during applicable activities off Virginia and Florida, as outlined in Table 5.3-6. In Phase II, the aircraft overflight noise mitigation measures were based on the Navy's operational assessments. The Navy determined that the current mitigation measures are the largest areas within which it is practical to implement mitigation for aircraft overflight noise; therefore, it will continue implementing the same procedural mitigation measures for Phase III.

Section 3.9.3.1.6 (Impacts from Aircraft Overflight Noise) provides a full analysis of the potential impacts of aircraft noise on birds. One of the highest concentration areas for rotary-wing aircraft training is located adjacent to fleet concentration areas at Naval Station Norfolk in the lower Chesapeake Bay and off the coast of Virginia Beach, Virginia. This area is located nearby important nesting habitat for the ESA-listed piping plover and other birds that breed along Virginia's barrier islands. The Navy's mitigation for aircraft overflight noise off Virginia will help avoid potential disturbances to nesting birds within the Virginia Capes Range Complex and Fisherman Island National Wildlife Refuge during applicable activities.

The Key West Range Complex contains Fort Jefferson, which is listed on the National Register of Historic Places. Fragile mortar in Fort Jefferson's brick masonry is susceptible to damage from sonic booms (Hanson et al., 1991; James et al., 2009). As described in Section 3.10.2.3 (Tortugas Military Operations Area), the Navy established the Tortugas Military Operations Area in 2009 to reduce potential impacts of sonic booms on Fort Jefferson. The Navy's mitigation is designed to help preserve the structural integrity of this cultural resource. The mitigation also helps the Navy avoid or reduce potential impacts from aircraft overflight noise on a nesting colony of roseate terns in the Dry Tortugas Islands.

Table 5.3-6: Procedural Mitigation for Aircraft Overflight Noise

Procedural Mitigation Description
Stressor or Activity • Aircraft overflight noise
Resource Protection Focus • Birds (ESA-listed piping plovers and other nesting birds in Virginia; roseate terns in Florida) • Cultural resources (Fort Jefferson)
Number of Lookouts and Observation Platform • Not applicable
Mitigation Requirements • 1 nautical mile (NM) from the beach within the Virginia Capes Range Complex during explosive mine neutralization activities involving Navy divers: – Maneuver to maintain distance (except when transiting offshore from Norfolk Naval Station). • 3,000 ft. altitude and 1,000 yd. from Fisherman Island National Wildlife Refuge off the coast of Cape Charles, Virginia during explosive mine neutralization activities involving Navy divers: – When transiting offshore from Norfolk Naval Station, maneuver to maintain altitude and distance. • Within the Tortugas Military Operations Area (12 NM from shore within the Dry Tortugas Islands): – Do not conduct air combat maneuver flights below 5,000 ft. or tactical maneuvers resulting in supersonic flights below 20,000 ft. – Conduct aircraft activities in the airspace adjacent to Fort Jefferson in a manner that will avoid or reduce sonic booms to the maximum extent practicable. This includes conducting training flights predisposed to supersonic conditions within designated airspace at least 30 NM from Fort Jefferson. – The Navy will incorporate mitigation instructions into pre-flight planning guidance for applicable aircrews.

Increasing mitigation would result in aircraft flying at a higher altitude, farther offshore, or in locations that could potentially interfere with established commercial air traffic routes. Extending distance offshore would increase transit distance and pilot fatigue and would accelerate the fatigue-life of aircraft. Interfering with commercial air traffic routes would increase safety risks to the commercial aircraft, Navy aircraft, and the personnel or civilians on board. In addition to these increased safety risks, the extending distances offshore would increase transit distances and result in additional operational costs due to increased fuel consumption.

In summary, the operational community determined that implementing procedural mitigation for aircraft overflight noise beyond what is detailed in Table 5.3-6 would be incompatible with the practicality assessment criteria for safety and sustainability.

5.3.3 Explosive Stressors

The Navy will implement procedural mitigation to avoid or reduce potential impacts on biological resources from the explosive stressors or activities discussed in the sections below. Section 3.7.3.2 (Explosive Stressors) and Section 3.8.3.2 (Explosive Stressors) provide a full analysis of potential impacts of explosives on marine mammals and sea turtles, respectively, including predicted impact ranges.

5.3.3.1 Explosive Sonobuoys

The Navy will continue to implement procedural mitigation to avoid or reduce potential impacts on marine mammals and sea turtles from explosive sonobuoys, as outlined in Table 5.3-7. In addition to procedural mitigation, the Navy will implement mitigation for the use of Improved Extended Echo Ranging Sonobuoys within mitigation areas (see Section 5.4.2, Mitigation Areas off the Northeastern

United States; Section 5.4.3, Mitigation Areas off the Mid-Atlantic and Southeastern United States; and Section 5.4.4, Mitigation Areas in the Gulf of Mexico).

Table 5.3-7: Procedural Mitigation for Explosive Sonobuoys

Procedural Mitigation Description
Stressor or Activity • Explosive sonobuoys
Resource Protection Focus • Marine mammals • Sea turtles
Number of Lookouts and Observation Platform • 1 Lookout positioned in an aircraft or on small boat • If additional platforms are participating in the activity, personnel positioned in those assets (e.g., safety observers, evaluators) will support observing the mitigation zone for applicable biological resources while performing their regular duties.
Mitigation Requirements • Mitigation zone: – 600 yd. around an explosive sonobuoy • Prior to the initial start of the activity (e.g., during deployment of a sonobuoy field, which typically lasts 20–30 min.): – Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear. – Conduct passive acoustic monitoring for marine mammals; use information from detections to assist visual observations. – Visually observe the mitigation zone for marine mammals and sea turtles; if observed, relocate or delay the start of sonobuoy or source/receiver pair detonations. • During the activity: – Observe the mitigation zone for marine mammals and sea turtles; if observed, cease sonobuoy or source/receiver pair detonations. • Commencement/recommencement conditions after a marine mammal or sea turtle sighting before or during the activity: – The Navy will allow a sighted marine mammal or sea turtle to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing detonations) until one of the following conditions has been met: (1) the animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the sonobuoy; or (3) the mitigation zone has been clear from any additional sightings for 10 min. when the activity involves aircraft that have fuel constraints, or 30 min. when the activity involves aircraft that are not typically fuel constrained. • After completion of the activity (e.g., prior to maneuvering off station): – When practical (e.g., when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), observe the vicinity of where detonations occurred; if any injured or dead marine mammals or ESA-listed species are observed, follow established incident reporting procedures. – If additional platforms are supporting this activity (e.g., providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

In Phase II, explosive sonobuoys had two mitigation zone sizes based on net explosive weight and the associated average ranges to PTS. When developing Phase III mitigation, the Navy analyzed the potential for increasing the size of these mitigation zones. The Navy identified an opportunity to increase the mitigation zone size by 250 yd. for sonobuoys using up to 2.5-lb. net explosive weight so that explosive sonobuoys will implement a 600-yd. mitigation zone, regardless of net explosive weight, to enhance protections to the maximum extent practicable. This increase is reflected in Table 5.3-7. The mitigation zone for explosive sonobuoys is now based on the largest area within which it is practical to implement mitigation.

The Navy is clarifying that it will require observation of the mitigation zone prior to the initial start of the activity to ensure the area is clear of applicable biological resources. The Navy has always verified that the mitigation zone is visually clear prior to conducting explosive activities and is more clearly capturing this current practice in the mitigation measures for Phase III. The Navy developed a new mitigation measure requiring the Lookout to observe the mitigation zone after completion of the activity. The Navy currently conducts post-activity observations for some, but not all explosive activities. In developing mitigation for Phase III, the Navy determined that it could expand this requirement to other explosive activities for enhanced consistency and to help determine if any resources were injured during explosive events, when practical. The Navy is adding a requirement that additional platforms already participating in the activity will support observing the mitigation zone before, during, and after the activity while performing their regular duties. There are typically multiple platforms in the vicinity of activities that use explosive sonobuoys (e.g., safety aircraft). When available, having additional personnel support observations of the mitigation zone will help increase the likelihood of detecting biological resources. The Navy will follow the incident reporting procedures outlined in Section 5.1.2.2.3 (Incident Reports) if an incident is detected at any time during the event, including during the post-activity observations.

Some activities that use explosive sonobuoys involve detonations of a single sonobuoy or sonobuoy pair, while other activities involve deployment of a field of sonobuoys that may be dispersed over a large distance. Lookouts will have a better likelihood of detecting marine mammals and sea turtles when observing the mitigation zone around a single sonobuoy, sonobuoy pair, or a smaller sonobuoy field than when observing a sonobuoy field dispersed over a large distance. When observing large sonobuoy fields, Lookouts will be more likely to detect large visual cues (e.g., whale blows or large pods of dolphins) than individual marine mammals, cryptic marine mammal species, and sea turtles. Observing for indicators of marine mammal and sea turtle presence will further help avoid or reduce potential impacts on these resources within the mitigation zones.

Bin E4 (e.g., Improved Extended Echo Ranging Sonobuoys) has the longest predicted impact ranges for explosive sonobuoys used in the Study Area. For the largest explosive in bin E4, the mitigation zone extends beyond the ranges to 50 percent non-auditory injury and 50 percent mortality for sea turtles and marine mammals. The mitigation zone extends beyond the average ranges to PTS for sea turtles, mid-frequency cetaceans, and sirenians, and into a portion of the average ranges to PTS for high-frequency cetaceans, low-frequency cetaceans, and phocids. The mitigation zone also extends into a portion of the average ranges to TTS for sea turtles and marine mammals. Therefore, depending on the species, mitigation will help avoid or reduce all or a portion of the potential for exposure to mortality, non-auditory injury, PTS, and higher levels of TTS for the largest explosives in bin E4. Smaller explosives in bin E4 and explosives in smaller source bins (E1, E3) have shorter predicted impact ranges; therefore, the mitigation zone will extend further beyond or cover a greater portion of the impact ranges for these explosives.

As described previously, the Phase III mitigation zone is based on the largest area within which it is practical for the Navy to implement mitigation. It is not practical to increase the mitigation zone because observations within the margin of increase would be ineffective unless the Navy allocated additional platforms to observe for biological resources. This is particularly true when observations occur from a small boat or during observations of a large field of sonobuoys. The use of additional personnel and equipment (aircraft or small boats) would be unsustainable due to increased operational costs and an exceedance of the available manpower and resources for this activity. Adding aircraft to observe the mitigation zone could result in airspace conflicts with the event participants. This would either require the aircraft conducting the activity to modify their flights plans (which would reduce activity realism) or force the observing aircraft to position itself a safe distance away from the activity area (which would decrease observation effectiveness). Adding vessels to observe the mitigation zone would increase safety risks due to the presence of observation vessels within the vicinity of explosive sonobuoys or an explosive sonobuoy field.

Increasing the mitigation zone size would result in a larger area over which detonations would need to be ceased in response to a sighting, and therefore would likely increase the number of times detonations would be ceased and would extend the length of the activity. These impacts would significantly diminish event realism in a way that would prevent the activity from meeting its intended objectives. For example, during Sonobuoy Lot Acceptance Testing, additional ceasing of the activity would not allow the Navy to effectively verify the integrity and performance of a lot or group of sonobuoys before full-scale production or delivery to the fleet. Such testing is required to ensure functionality and accuracy in military mission and combat conditions. Extending the length of the activity would require aircraft to depart the area to refuel. If multiple refueling events were required, the activity length would extend by two to five times or more, which would decrease the ability for Lookouts to safely and effectively maintain situational awareness of the activity area and increase safety risks due to increased pilot fatigue and accelerated fatigue-life of aircraft. Extending the length of the activity would also result in additional operational costs due to increased fuel consumption.

In summary, the operational community determined that implementing procedural mitigation for explosive sonobuoys beyond what is detailed in Table 5.3-7 would be incompatible with the practicality assessment criteria for safety, sustainability, and mission requirements.

5.3.3.2 Explosive Torpedoes

The Navy will continue to implement procedural mitigation to avoid or reduce potential impacts on marine mammals and sea turtles from explosive torpedoes, as outlined in Table 5.3-8. In addition to procedural mitigation, the Navy will implement mitigation for explosive torpedoes within mitigation areas (see Section 5.4.2, Mitigation Areas off the Northeastern United States; Section 5.4.3, Mitigation Areas off the Mid-Atlantic and Southeastern United States; and Section 5.4.4, Mitigation Areas in the Gulf of Mexico).

In Phase II, the explosive torpedo mitigation zone was based on net explosive weight and the associated average ranges to PTS. When developing Phase III mitigation, the Navy analyzed the potential for increasing the size of this mitigation zone. The Navy determined that the current mitigation zone is the largest area within which it is practical to implement mitigation for this activity; therefore, it will continue implementing this same mitigation zone for Phase III. The post-activity observations for explosive torpedoes are a continuation from Phase II and will help the Navy determine if any resources were injured during the activity. The Navy will follow the incident reporting procedures outlined in Section 5.1.2.2.3 (Incident Reports) if an incident is detected at any time during the event, including during the post-activity observations.

The Navy is clarifying that it will require observation of the mitigation zone prior to the initial start of the activity to ensure the area is clear of applicable biological resources. The Navy has always verified that the mitigation zone is visually clear prior to conducting explosive activities and is more clearly capturing this current practice in the mitigation measures for Phase III. The Navy is adding a requirement that additional platforms already participating in the activity will support observing the mitigation zone before, during, and after the activity while performing their regular duties. Typically, when aircraft are firing explosive torpedoes, there are additional observation aircraft, support vessels (e.g., range craft for torpedo retrieval), or other safety aircraft in the vicinity. When available, having additional personnel support observations of the mitigation zone will help increase the likelihood of detecting biological resources.

Table 5.3-8: Procedural Mitigation for Explosive Torpedoes

Procedural Mitigation Description
Stressor or Activity • Explosive torpedoes
Resource Protection Focus • Marine mammals • Sea turtles
Number of Lookouts and Observation Platform • 1 Lookout positioned in an aircraft • If additional platforms are participating in the activity, personnel positioned in those assets (e.g., safety observers, evaluators) will support observing the mitigation zone for applicable biological resources while performing their regular duties.
Mitigation Requirements • Mitigation zone: – 2,100 yd. around the intended impact location • Prior to the initial start of the activity (e.g., during deployment of the target): – Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear. – Conduct passive acoustic monitoring for marine mammals; use information from detections to assist visual observations. – Visually observe the mitigation zone for marine mammals, sea turtles, and jellyfish aggregations; if observed, relocate or delay the start of firing. • During the activity: – Observe the mitigation zone for marine mammals, sea turtles, and jellyfish aggregations; if observed, cease firing. • Commencement/recommencement conditions after a marine mammal or sea turtle sighting before or during the activity: – The Navy will allow a sighted marine mammal or sea turtle to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following conditions has been met: (1) the animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; or (3) the mitigation zone has been clear from any additional sightings for 10 min. when the activity involves aircraft that have fuel constraints, or 30 min. when the activity involves aircraft that are not typically fuel constrained. • After completion of the activity (e.g., prior to maneuvering off station): – When practical (e.g., when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), observe the vicinity of where detonations occurred; if any injured or dead marine mammals or ESA-listed species are observed, follow established incident reporting procedures. – If additional platforms are supporting this activity (e.g., providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

Explosive torpedo activities involve detonations at a target located down range of the firing platform. Due to the distance between the mitigation zone and the observation platform, Lookouts will have a better likelihood of detecting large visual cues (e.g., whale blows or large pods of dolphins) than individual marine mammals, cryptic marine mammal species, and sea turtles. As described in Chapter 3.8 (Reptiles), some species of sea turtles forage on jellyfish, and some of the locations (such as off the northeastern United States) where explosive torpedo activities could occur support high densities of jellyfish throughout parts of the year. Observing for indicators of marine mammal and sea turtle presence (including jellyfish aggregations) will further help avoid or reduce potential impacts on these resources within the mitigation zone.

Bin E11 has the longest predicted impact ranges for explosive torpedoes used in the Study Area. For the largest explosive in bin E11, the mitigation zone extends beyond the ranges to 50 percent non-auditory injury and 50 percent mortality for sea turtles and marine mammals. The mitigation zone extends beyond the average ranges to PTS for sea turtles, mid-frequency cetaceans, and sirenians, and into a portion of the average ranges to PTS for high-frequency cetaceans, low-frequency cetaceans, and phocids. The mitigation zone also extends into a portion of the average ranges to TTS for sea turtles and marine mammals. Therefore, depending on the species, mitigation will help avoid or reduce all or a portion of the potential for exposure to mortality, non-auditory injury, PTS, and higher levels of TTS for the largest explosives in bin E11. Explosive torpedoes in smaller source bins (e.g., E8) have shorter predicted impact ranges; therefore, the mitigation zone will extend further beyond or cover a greater portion of the impact ranges for these explosives.

As described previously, the Phase III mitigation zone is based on the largest area within which it is practical for the Navy to implement mitigation. It is not practical to increase this mitigation zone because observations within the margin of increase would be ineffective unless the Navy allocated additional platforms to observe for biological resources. The use of additional personnel and observation platforms would be unsustainable due to increased operational costs and an exceedance of the available manpower and resources for this activity. Adding aircraft to observe the mitigation zone could result in airspace conflicts with the event participants. This would either require the aircraft participating in the activity to modify their flights plans (which would reduce activity realism) or force the observing aircraft to position itself a safe distance away from the activity area (which would decrease observation effectiveness). Adding vessels to observe the mitigation zone would increase safety risks due to the presence of observation vessels within the vicinity of explosive torpedoes.

Increasing the mitigation zone size would result in a larger area over which detonations would need to be ceased in response to a sighting, and therefore would likely increase the number of times detonations would be ceased and would extend the length of the activity. These impacts would significantly diminish event realism in a way that would prevent the activity from meeting its intended objectives. For example, the Navy conducts Torpedo (Explosive) Testing events to test the functionality of torpedoes and torpedo launch systems. These events often involve aircrews locating, approaching, and firing a torpedo on an artificial target. They require focused situational awareness of the activity area and continuous coordination between the participating platforms as required during military missions and combat operations. Extending the length of the activity would require aircraft to depart the area to refuel. If the firing aircraft departed the activity location to refuel, the aircrew would lose the ability to maintain situational awareness and effectively coordinate with other participating platforms. If multiple refueling events were required, the activity length would extend by two to five times or more, which would increase safety risks due to increased pilot fatigue and accelerated fatigue-life of aircraft. Therefore, an increase in mitigation would impede the Navy’s ability to meet testing requirements per required acquisition milestones or on an as-needed basis to meet operational requirements. Extending the length of the activity would also result in additional operational costs due to increased fuel consumption.

In summary, the operational community determined that implementing procedural mitigation for explosive torpedoes beyond what is detailed in Table 5.3-8 would be incompatible with the practicality assessment criteria for safety, sustainability, and mission requirements.

5.3.3.3 Explosive Medium-Caliber and Large-Caliber Projectiles

The Navy will continue to implement procedural mitigation to avoid or reduce potential impacts on marine mammals and sea turtles from explosive gunnery activities, as outlined in Table 5.3-9. In addition to procedural mitigation, the Navy will implement mitigation for explosive gunnery activities within mitigation areas (see Section 5.4.1, Mitigation Areas for Seafloor Resources; Section 5.4.2, Mitigation Areas off the Northeastern United States; Section 5.4.3, Mitigation Areas off the Mid-Atlantic and Southeastern United States; and Section 5.4.4, Mitigation Areas in the Gulf of Mexico).

Table 5.3-9: Procedural Mitigation for Explosive Medium-Caliber and Large-Caliber Projectiles

Procedural Mitigation Description
Stressor or Activity • Gunnery activities using explosive medium-caliber and large-caliber projectiles   – Mitigation applies to activities using a surface target
Resource Protection Focus • Marine mammals • Sea turtles
Number of Lookouts and Observation Platform • 1 Lookout on the vessel or aircraft conducting the activity   – For activities using explosive large-caliber projectiles, depending on the activity, the Lookout could be the same as the one described in Section 5.3.2.4 (Weapons Firing Noise). • If additional platforms are participating in the activity, personnel positioned in those assets (e.g., safety observers, evaluators) will support observing the mitigation zone for applicable biological resources while performing their regular duties.

Mitigation Requirements
• Mitigation zones:
  – 200 yd. around the intended impact location for air-to-surface activities using explosive medium-caliber projectiles
  – 600 yd. around the intended impact location for surface-to-surface activities using explosive medium-caliber projectiles
  – 1,000 yd. around the intended impact location for surface-to-surface activities using explosive large-caliber projectiles
• Prior to the initial start of the activity (e.g., when maneuvering on station):
  – Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear.
  – Observe the mitigation zone for marine mammals and sea turtles; if observed, relocate or delay the start of firing.
• During the activity:
  – Observe the mitigation zone for marine mammals and sea turtles; if observed, cease firing.
• Commencement/recommencement conditions after a marine mammal or sea turtle sighting before or during the activity:
  – The Navy will allow a sighted marine mammal or sea turtle to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following conditions has been met: (1) the animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; (3) the mitigation zone has been clear from any additional sightings for 10 min. for aircraft-based firing or 30 min. for vessel-based firing; or (4) for activities using mobile targets, the intended impact location has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.
• After completion of the activity (e.g., prior to maneuvering off station):
  – When practical (e.g., when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), observe the vicinity of where detonations occurred; if any injured or dead marine mammals or ESA-listed species are observed, follow established incident reporting procedures.
  – If additional platforms are supporting this activity (e.g., providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

In Phase II, explosive gunnery activity mitigation zones were based on net explosive weight and the associate average ranges to PTS. When developing Phase III mitigation, the Navy analyzed the potential for increasing the size of these mitigation zones. The Navy identified an opportunity to increase the mitigation zone size by 400 yd. for surface-to-surface activities to enhance protections to the maximum extent practicable. This increase is reflected in Table 5.3-9. The mitigation zones for explosive medium-caliber and large-caliber projectiles are now based on the largest areas within which it is practical to implement mitigation.

The Navy is clarifying that it will require observation of the mitigation zone prior to the initial start of the activity to ensure the area is clear of applicable biological resources. The Navy has always verified that the mitigation zone is visually clear prior to conducting explosive activities and is more clearly capturing this current practice in the mitigation measures for Phase III. The Navy developed a new mitigation measure requiring the Lookout to observe the mitigation zone after completion of the activity. The Navy currently conducts post-activity observations for some, but not all explosive activities. In developing mitigation for Phase III, the Navy determined that it could expand this requirement to other explosive activities for enhanced consistency and to help determine if any resources were injured during explosive events, when practical. The Navy is adding a requirement that additional platforms already participating in the activity will support observing the mitigation zone before, during, and after the activity while performing their regular duties. Typically, when aircraft are firing explosive munitions there are additional observation aircraft, multiple aircraft firing munitions, or other safety aircraft in the vicinity. When available, having additional personnel support observations of the mitigation zone will help increase the likelihood of detecting biological resources. The Navy will follow the incident reporting procedures outlined in Section 5.1.2.2.3 (Incident Reports) if an incident is detected at any time during the event, including during the post-activity observations.

Large-caliber gunnery activities involve vessels firing projectiles at targets located up to 6 NM down range. Medium-caliber gunnery activities involve vessels or aircraft firing projectiles at targets located up to 4,000 yd. down range, although typically much closer. As described in Section 5.2.1 (Procedural Mitigation Development), certain platforms, such as the small boats and aircraft used during explosive medium-caliber gunnery exercises, have manning or space restrictions; therefore, the Lookout for these activities is typically an existing member of the aircraft or boat crew who is responsible for other essential tasks (e.g., navigation). Due to their relatively lower vantage point, Lookouts on vessels (during medium-caliber or large-caliber gunnery exercises) will be more likely to detect large visual cues (e.g., whale blows or large pods of dolphins) than individual marine mammals, cryptic marine mammal species, and sea turtles when observing around targets located at the furthest firing distances. The Navy will implement larger mitigation zones for large-caliber gunnery activities than for medium-caliber gunnery activities due to the nature of how the activities are conducted. For example, large-caliber gunnery activities are conducted from surface combatants, so Lookouts can observe a larger mitigation zone because they typically have access to high-powered binoculars mounted on the ship deck. This will enable observation of the distant mitigation zone in combination with hand-held binoculars and naked-eye scanning. Lookouts in aircraft (during medium-caliber gunnery exercises), have a relatively higher vantage point for observing the mitigation zones but will still be more likely to detect individual marine mammals and sea turtles when observing mitigation zones located close to the firing platform than at the furthest firing distances. Observing for indicators of marine mammal and sea turtle presence will further help avoid or reduce potential impacts on these resources within the mitigation zones.

The mitigation applies only to activities using surface targets. Most airborne targets are recoverable aerial drones that are not intended to be hit by ordnance. Given the speed of the projectiles and mobile target, and the long ranges that projectiles typically travel, it is not possible to definitively predict or to effectively observe where the projectile fragments will fall. For gunnery activities using explosive medium-caliber and large-caliber projectiles, the potential military expended material fall zone can only be predicted within thousands of yards, which can be up to 6 NM from the firing location. These areas are too large to be effectively observed for marine mammals and sea turtles with the number of personnel and platforms available for this activity. The potential risk to marine mammals and sea turtles during events using airborne targets is limited to the animal being directly struck by falling military expended materials. There is no potential for direct impact from the explosives because the detonations occur in air. Based on the extremely low potential for projectile fragments to co-occur in space and time with a marine mammal or sea turtle at or near the surface of the water, the potential for a direct strike is negligible; therefore, mitigation for gunnery activities using airborne targets would not be effective at avoiding or reducing potential impacts. Additional information on military expended materials is provided in Appendix F (Military Expended Material and Direct Strike Impact Analysis).

Bin E5 (e.g., 5-in. projectiles) has the longest predicted impact ranges for explosive projectiles that apply to the 1,000-yd. mitigation zone. Bin E2 (e.g., 40-millimeter [mm] projectiles) has the longest predicted impact ranges for explosive projectiles that apply to the 600-yd. and 200-yd. mitigation zones. The 1,000-yd., 600-yd., and 200-yd. mitigation zones extend beyond the respective ranges to 50 percent non-auditory injury and 50 percent mortality for sea turtles and marine mammals. The mitigation zones extend beyond the respective average ranges to PTS for sea turtles and all marine mammal hearing groups except high-frequency cetaceans (the mitigation zones extend into a portion of the respective average ranges to PTS for this hearing group). The mitigation zones also extend into a portion of the average ranges to TTS for sea turtles and marine mammals. Therefore, depending on the species, mitigation will help avoid or reduce all or a portion of the potential for exposure to mortality, non-auditory injury, PTS, and higher levels of TTS for the largest explosives in bin E5 and bin E2. Explosives in smaller source bins (e.g., E1) have shorter predicted impact ranges; therefore, the mitigation zones will extend further beyond or cover a greater portion of the impact ranges for these explosives.

As described previously, the Phase III mitigation zones are based on the largest areas within which it is practical for the Navy to implement mitigation. It is not practical to increase these mitigation zones because observations within the margin of increase would be unsafe and ineffective. One of the mission-essential safety protocols for explosive gunnery activities is a requirement for event participants (including Lookouts) to maintain focus on the activity area to ensure safety of Navy personnel and equipment, and the public. For example, when air-to-surface medium-caliber gunnery exercises involve fighter aircraft descending on a target, or rotary-wing aircraft flying a racetrack pattern and descending on a target using a forward-tilted firing angle, maintaining attention on the activity area is paramount to aircraft safety. The typical activity areas for medium-caliber and large-caliber gunnery activities coincide with the applicable mitigation zones developed for Phase III; therefore, Lookouts can safely and effectively observe the mitigation zones for biological resources while simultaneously maintaining focus on the activity areas. However, if the mitigation zone sizes increased, Lookouts would need to redirect their attention to observe beyond the activity area. This would not meet the safety criteria since personnel would be required to direct attention away from mission requirements. Alternatively, the Navy would need to add personnel to serve as additional Lookouts on the existing observation platforms or allocate additional platforms to the activity to observe for biological resources. These actions would not be safe or sustainable due to an exceedance of manpower, resource, and space restrictions for these activities. Similarly, positioning platforms closer to the intended impact location would increase safety risks related to proximity to the detonation location and path of the explosive projectile.

Increasing the mitigation zone sizes would result in larger areas over which detonations would need to be ceased in response to a sighting, and therefore would likely increase the number of times firing would be ceased and would extend the length of the activity. These impacts would significantly diminish event realism in a way that would prevent activities from meeting their intended objectives. For example, the Navy must train its gun crews to coordinate with other participating platforms (e.g., small boats launching a target, other firing platforms), locate and engage surface targets (e.g., high speed maneuverable surface targets), and practice precise defensive marksmanship to disable threats. The Navy must test the functionality of its guns in advance of delivery to the fleet for operational use.

Depending on the type of target being used, additional stopping of the activity could result in the target needing to be recovered and relaunched, which would cause a significant loss of training or testing time. For activities that involve aircraft, extending the length of the activity would require aircraft to depart the area to refuel. If multiple refueling events were required, the length of the activity would be extended by two to five times or more, which would decrease the ability for Lookouts to safely and effectively maintain situational awareness of the activity area and increase safety risks due to increased pilot fatigue and accelerated fatigue-life of aircraft. These types of impacts would reduce the number of opportunities that gun crews have to fire on the target and cause significant delays to the training or testing schedule. Therefore, an increase in mitigation would impede the ability for gun crews to train and become proficient in using their weapons as required during military missions and combat operations, would prevent units from meeting their individual training and certification requirements (which would prevent them from deploying with the required level of readiness necessary to accomplish their missions), and would impede the ability of program managers and weapons system acquisition programs to meet testing requirements per required acquisition milestones or on an as-needed basis to meet operational requirements. Extending the length of the activity would also result in additional operational costs due to increased fuel consumption.

In summary, the operational community determined that implementing procedural mitigation for explosive medium-caliber and large-caliber projectiles beyond what is detailed in Table 5.3-9 would be incompatible with the practicality assessment criteria for safety, sustainability, and mission requirements.

5.3.3.4 Explosive Missiles and Rockets

The Navy will continue to implement procedural mitigation to avoid or reduce potential impacts on marine mammals and sea turtles from explosive missiles and rockets, as outlined in Table 5.3-10. In addition to procedural mitigation, the Navy will implement mitigation for explosive missiles and rockets within mitigation areas (see Section 5.4.1, Mitigation Areas for Seafloor Resources; Section 5.4.2, Mitigation Areas off the Northeastern United States; Section 5.4.3, Mitigation Areas off the Mid-Atlantic and Southeastern United States, and Section 5.4.4, Mitigation Areas in the Gulf of Mexico).

In Phase II, explosive missile and rocket mitigation zones were based on net explosive weight and the associate average ranges to PTS. When developing Phase III mitigation, the Navy analyzed the potential for increasing the mitigation zone sizes. The Navy identified an opportunity to increase the mitigation zone by 1,100 yd. for missiles and rockets using 21–250 lb. net explosive weight to enhance protections to the maximum extent practicable. This increase is reflected in Table 5.3-10. The mitigation zones are now based on the largest areas within which it is practical to implement mitigation.

The Navy is clarifying that it will require observation of the mitigation zone prior to the initial start of the activity to ensure the area is clear of applicable biological resources. The Navy has always verified that the mitigation zone is visually clear prior to conducting explosive activities and is more clearly capturing this current practice in the mitigation measures for Phase III. The Navy developed a new mitigation measure requiring the Lookout to observe the mitigation zone after completion of the activity. The Navy currently conducts post-activity observations for some, but not all explosive activities. In developing mitigation for Phase III, the Navy determined that it could expand this requirement to other explosive activities for enhanced consistency and to help determine if any resources were injured during explosive events, when practical. The Navy is adding a requirement that additional platforms already participating in the activity will support observing the mitigation zone before, during, and after the activity while performing their regular duties. Typically, when aircraft are firing explosive munitions there are additional observation aircraft, multiple aircraft firing munitions, or other safety aircraft in the vicinity. For example, during typical explosive missile exercises, two aircraft circle the activity location, one aircraft clears the intended impact location while the other fires, and vice versa. A third aircraft is typically present for safety or proficiency inspections. When available, having additional personnel support observations of the mitigation zone will help increase the likelihood of detecting biological resources. The Navy will follow the incident reporting procedures outlined in Section 5.1.2.2.3 (Incident Reports) if an incident is detected at any time during the event, including during the post-activity observations.

Table 5.3-10: Procedural Mitigation for Explosive Missiles and Rockets

Procedural Mitigation Description
Stressor or Activity • Aircraft-deployed explosive missiles and rockets – Mitigation applies to activities using a surface target
Resource Protection Focus • Marine mammals • Sea turtles
Number of Lookouts and Observation Platform • 1 Lookout positioned in an aircraft • If additional platforms are participating in the activity, personnel positioned in those assets (e.g., safety observers, evaluators) will support observing the mitigation zone for applicable biological resources while performing their regular duties.
Mitigation Requirements • Mitigation zones: – 900 yd. around the intended impact location for missiles or rockets with 0.6–20 lb. net explosive weight – 2,000 yd. around the intended impact location for missiles with 21–500 lb. net explosive weight • Prior to the initial start of the activity (e.g., during a fly-over of the mitigation zone): – Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear. – Observe the mitigation zone for marine mammals and sea turtles; if observed, relocate or delay the start of firing. • During the activity: – Observe the mitigation zone for marine mammals and sea turtles; if observed, cease firing. • Commencement/recommencement conditions after a marine mammal or sea turtle sighting before or during the activity: – The Navy will allow a sighted marine mammal or sea turtle to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following conditions has been met: (1) the animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; or (3) the mitigation zone has been clear from any additional sightings for 10 min. when the activity involves aircraft that have fuel constraints, or 30 min. when the activity involves aircraft that are not typically fuel constrained. • After completion of the activity (e.g., prior to maneuvering off station): – When practical (e.g., when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), observe the vicinity of where detonations occurred; if any injured or dead marine mammals or ESA-listed species are observed, follow established incident reporting procedures. – If additional platforms are supporting this activity (e.g., providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

Missile and rocket exercises involve firing munitions at a target typically located up to 15 NM down range, and infrequently up to 75 NM down range. Due to the distance between the mitigation zone and the observation platform, Lookouts will have a better likelihood of detecting marine mammals and sea turtles during close-range observations and are less likely to detect these resources once positioned at the firing location, particularly individual marine mammals, cryptic marine mammal species, and sea turtles. There is a chance that animals could enter the mitigation zone after the aircraft conducts its close-range mitigation zone observations and before firing begins (once the aircraft has transited to its firing position). Observing for indicators of marine mammal and sea turtle presence will further help avoid or reduce potential impacts on these resources within the mitigation zones.

The Navy will implement larger mitigation zones for missiles using 21–500 lb. net explosive weight than for missiles and rockets using 0.6–20 lb. net explosive weight due to the nature of how these activities are conducted. During activities using missiles in the larger net explosive weight category, the firing aircraft (e.g., maritime patrol aircraft) have the capability of mitigating a larger area due to their larger fuel capacity. During activities using missiles or rockets in the smaller net explosive weight category, the firing aircraft (e.g., rotary-wing aircraft) are typically constrained by their fuel capacity.

The mitigation applies to aircraft-deployed missiles and rockets because aircraft can fly over the intended impact area prior to commencing firing. Mitigation would be ineffective for vessel-deployed missiles and rockets because of the inability for a Lookout to detect marine mammals or sea turtles from a vessel from the distant firing position. It would not be effective or practical to have a vessel conduct close-range observations of the mitigation zone prior to firing due to the length of time it would take to complete observations and transit back to the firing position, and the costs associated with increased fuel consumption.

The mitigation applies to activities using surface targets. Most airborne targets are recoverable aerial drones that are not intended to be hit by ordnance. For example, telemetry-configured anti-air missiles used in training are designed to detonate or simulate a detonation near a target, but not as a result of a direct strike on a target. Given the speed of missiles and mobile targets, the high altitudes involved, and the long ranges that missiles typically travel, it is not possible to definitively predict or to effectively observe where the missile fragments will fall. The potential expended material fall zone can only be predicted within tens of miles for long range events, which can be 75 NM from the firing location; and thousands of yards for short range events, which can occur 15 NM from the firing location. These areas are too large to be effectively observed for marine mammals and sea turtles with the number of personnel and platforms available for this activity. The potential risk to marine mammals and sea turtles during events using airborne targets is limited to the animal being directly struck by falling military expended materials. There is no potential for direct impact from the explosives because the detonations occur in air. Based on the extremely low potential for military expended materials to co-occur in space and time with a marine mammal or sea turtle at or near the surface of the water, the potential for a direct strike is negligible; therefore, mitigation would not be effective at avoiding or reducing impacts. Additional information on military expended materials is provided in Appendix F (Military Expended Material and Direct Strike Impact Analysis).

Bin E10 (e.g., Harpoon missiles) has the longest predicted impact ranges for explosive missiles that apply to the 2,000-yd. mitigation zone. Bin E6 (e.g., Hellfire missiles) has the longest predicted impact ranges for explosive missiles and rockets that apply to the 900-yd. mitigation zone. The 2,000-yd. and 900-yd. mitigation zones extend beyond the respective ranges to 50 percent non-auditory injury and 50 percent mortality for sea turtles and marine mammals. The mitigation zones extend beyond the respective average ranges to PTS for sea turtles and all marine mammal hearing groups except high-frequency cetaceans (the mitigation zones extend into a portion of the respective average ranges to PTS for this hearing group). The mitigation zones also extend into a portion of the average ranges to TTS for sea turtles and marine mammals. Therefore, depending on the species, mitigation will help avoid or reduce all or a portion of the potential for exposure to mortality, non-auditory injury, PTS, and higher levels of TTS for the largest explosives in bin E10 and bin E6. Explosives in smaller source bins (e.g., missiles in bin E9, rockets in bin E3) have shorter predicted impact ranges; therefore, the mitigation zones will cover a greater portion of the impact ranges for these explosives.

As described previously, the Phase III mitigation zones are based on the largest areas within which it is practical for the Navy to implement mitigation. It is not practical to increase these mitigation zones because observations within the margin of increase would be unsafe and ineffective unless the Navy allocated additional platforms to the activity to observe for biological resources. The use of additional personnel and equipment (e.g., aircraft) would be unsustainable due to increased operational costs and an exceedance of the available manpower and resources for this activity. Adding aircraft to observe the mitigation zone could result in airspace conflicts with the event participants. This would either require the aircraft conducting the activity to modify their flights plans (which would reduce activity realism) or force the observing aircraft to position itself a safe distance away from the activity area (which would decrease observation effectiveness). Similarly, positioning platforms closer to the intended impact location (as would be required if mitigation applied to vessel-deployed missiles and rockets) would increase safety risks related to proximity to the detonation location and path of the explosive missile or rocket.

Increasing the mitigation zone sizes would result in larger areas over which firing would need to be ceased in response to a sighting, and therefore would likely increase the number of times detonations would be ceased and would extend the length of the activity. These impacts would significantly diminish event realism in a way that would prevent the activity from meeting its intended objectives. Explosive missile and rocket events require focused situational awareness of the activity area and continuous coordination between the participating platforms as required during military missions and combat operations. For activities using missiles in the larger net explosive weight category, the flyover distance between the mitigation zone and the firing location can extend upwards of 75 NM; therefore, even aircraft with larger fuel capacities would need to depart the activity area to refuel if the length of the activity was extended. If the firing aircraft departed the activity location to refuel, the aircrew would lose the ability to maintain situational awareness of the activity area and effectively coordinate with other participating platforms. If multiple refueling events were required, the activity length would extend by two to five times or more, which would increase safety risks due to increased pilot fatigue and accelerated fatigue-life of aircraft. These types of impacts would cause a significant loss of training or testing time, reduce the number of opportunities that aircrews have to fire on the target, and cause a significant delay to the training or testing schedule. Therefore, an increase in mitigation would impede the ability for aircrews to train and become proficient in using their weapons as required during military missions and combat operations, would prevent units from meeting their individual training and certification requirements (which would prevent them from deploying with the required level of readiness necessary to accomplish their missions), and would impede the ability of program managers and weapons system acquisition programs to meet testing requirements per required acquisition milestones or on an as-needed basis to meet operational requirements. Extending the length of the activity would also result in additional operational costs due to increased fuel consumption.

In summary, the operational community determined that implementing procedural mitigation for explosive missiles and rockets beyond what is detailed in Table 5.3-10 would be incompatible with the practicality assessment criteria for safety, sustainability, and mission requirements.

5.3.3.5 Explosive Bombs

The Navy will continue to implement procedural mitigation to avoid or reduce potential impacts on marine mammals and sea turtles from explosive bombs, as outlined in Table 5.3-11. In addition to procedural mitigation, the Navy will implement mitigation for explosive bombs within mitigation areas (see Section 5.4.1, Mitigation Areas for Seafloor Resources; Section 5.4.2, Mitigation Areas off the Northeastern United States; Section 5.4.3, Mitigation Areas off the Mid-Atlantic and Southeastern United States; and Section 5.4.4, Mitigation Areas in the Gulf of Mexico).

Table 5.3-11: Procedural Mitigation for Explosive Bombs

Procedural Mitigation Description
Stressor or Activity • Explosive bombs
Resource Protection Focus • Marine mammals • Sea turtles
Number of Lookouts and Observation Platform • 1 Lookout positioned in the aircraft conducting the activity • If additional platforms are participating in the activity, personnel positioned in those assets (e.g., safety observers, evaluators) will support observing the mitigation zone for applicable biological resources while performing their regular duties.
Mitigation Requirements • Mitigation zone: – 2,500 yd. around the intended target • Prior to the initial start of the activity (e.g., when arriving on station): – Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear. – Observe the mitigation zone for marine mammals and sea turtles; if observed, relocate or delay the start of bomb deployment. • During the activity (e.g., during target approach): – Observe the mitigation zone for marine mammals and sea turtles; if observed, cease bomb deployment. • Commencement/recommencement conditions after a marine mammal or sea turtle sighting before or during the activity: – The Navy will allow a sighted marine mammal or sea turtle to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing bomb deployment) until one of the following conditions has been met: (1) the animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended target; (3) the mitigation zone has been clear from any additional sightings for 10 min.; or (4) for activities using mobile targets, the intended target has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting. • After completion of the activity (e.g., prior to maneuvering off station): – When practical (e.g., when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), observe the vicinity of where detonations occurred; if any injured or dead marine mammals or ESA-listed species are observed, follow established incident reporting procedures. – If additional platforms are supporting this activity (e.g., providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

In Phase II, the explosive bombing mitigation zone was based on net explosive weight and the associated average ranges to PTS. When developing Phase III mitigation, the Navy analyzed the potential for increasing the size of this mitigation zone. The Navy determined that the current mitigation zone for explosive bombs is the largest area within which it is practical to implement mitigation for this activity; therefore, it will continue implementing this same mitigation zone for Phase III.

The Navy is clarifying that it will require observation of the mitigation zone prior to the initial start of the activity to ensure the area is clear of applicable biological resources. The Navy has always verified that the mitigation zone is visually clear prior to conducting explosive activities and is more clearly capturing this current practice in the mitigation measures for Phase III. The Navy developed a new mitigation measure requiring the Lookout to observe the mitigation zone after completion of this activity. The Navy currently conducts post-activity observations for some, but not all explosive activities. In developing mitigation for Phase III, the Navy determined that it could expand this requirement to other explosive activities for enhanced consistency and to help determine if any resources were injured during explosive events, when practical. The Navy is adding a requirement that additional platforms already participating in the activity will support observing the mitigation zone before, during, and after the activity while performing their regular duties. Typically, when aircraft are firing explosive munitions there are additional observation aircraft, multiple aircraft firing munitions, or other safety aircraft in the vicinity. When available, having additional personnel support observations of the mitigation zone will help increase the likelihood of detecting biological resources. The Navy will follow the incident reporting procedures outlined in Section 5.1.2.2.3 (Incident Reports) if an incident is detected at any time during the event, including during the post-activity observations.

Bombing exercises involve an aircraft deploying munitions at a surface target located beneath the firing platform. During target approach, aircraft maintain a relatively steady altitude of approximately 1,500 ft. Lookouts, by necessity for safety and mission success, primarily focus their attention on the water surface surrounding the intended detonation location (i.e., the mitigation zone). Being positioned in an aircraft gives the Lookout a good vantage point for observing marine mammals and sea turtles throughout the mitigation zone. Observing for indicators of marine mammal and sea turtle presence will further help avoid or reduce potential impacts on these resources within the mitigation zone.

Bin E12 (e.g., 2,000-lb. bombs) has the longest predicted impact ranges for explosive bombs used in the Study Area. The 2,500-yd. mitigation zone extends beyond the ranges to 50 percent non-auditory injury and 50 percent mortality for sea turtles and marine mammals. The mitigation zone extends beyond the average ranges to PTS for sea turtles and all marine mammal hearing groups except high-frequency cetaceans (the mitigation zones extend into a portion of the respective average ranges to PTS for this hearing group). The mitigation zone also extends into a portion of the average ranges to TTS for sea turtles and marine mammals. Therefore, depending on the species, mitigation will help avoid or reduce all or a portion of the potential for exposure to mortality, non-auditory injury, PTS, and higher levels of TTS for the largest bombs in bin E12. Smaller bombs (e.g., 250-lb. bombs, 500-lb. bombs) have shorter predicted impact ranges; therefore, the mitigation zone will extend further beyond or cover a greater portion of the impact ranges for these explosives.

As described previously, the Phase III mitigation zone is based on the largest area within which it is practical for the Navy to implement mitigation. It is not practical to increase this mitigation zone because observations within the margin of increase would be unsafe and ineffective unless the Navy allocated additional platforms to the activity to observe for biological resources. The use of additional personnel and aircraft would be unsustainable due to increased operational costs and an exceedance of the available manpower and resources for this activity. Adding aircraft to observe the mitigation zone could result in airspace conflicts with the event participants. This would either require the aircraft participating in the activity to modify their flights plans (which would reduce activity realism) or force the observing aircraft to position itself a safe distance away from the activity area (which would decrease observation effectiveness). Adding vessels to observe the mitigation zone would increase safety risks due to the presence of observation vessels within the vicinity of the intended explosive bomb detonation location.

Increasing the mitigation zone would result in a larger area over which explosive bomb deployment would need to be ceased in response to a sighting, and therefore would likely increase the number of times explosive bombing activities would be ceased and would extend the length of the activity. These impacts would significantly diminish event realism in a way that would prevent the activity from meeting its intended objectives. For example, critical components of a Bombing Exercise Air-to-Surface training activity are the assembly, loading, delivery, and assessment of an explosive bomb. The activity requires focused situational awareness of the activity area and continuous coordination between multiple training components. The training exercise starts with ground personnel, who must practice the building and loading of explosive munitions. Training includes the safe handling of explosive material, configuring munitions to precise specifications, and loading munitions onto aircraft. Aircrew must then identify a target and safely deliver fused munitions, discern if the bomb was assembled correctly, and determine bomb damage assessments based on how and where the explosive detonated. Extending the length of the activity would require aircraft to depart the area to refuel. If the firing aircraft departed the activity area to refuel, aircrew would lose the ability to maintain situational awareness of the activity area, effectively coordinate with other participating platforms, and complete all training components as required during military missions and combat operations. If multiple refueling events were required, the activity length would be extended by two to five times or more, which would cause a significant loss of training or testing time and would increase safety risks due to increased pilot fatigue and accelerated fatigue-life of aircraft. This which would reduce the number of opportunities that aircrews have to approach targets and deploy bombs and reduce the Navy's ability to evaluate the bomb, the bomb carry and delivery system, and any associated systems that may have been newly developed or enhanced, which would cause a significant delay to the training or testing schedule. Therefore, an increase in mitigation would impede the ability for aircrews to train and become proficient in using their weapons, would prevent units from meeting their individual training and certification requirements (which would prevent them from deploying with the required level of readiness necessary to accomplish their missions), and would impede the ability of program managers and weapons system acquisition programs to meet testing requirements per required acquisition milestones or on an as-needed basis to meet operational requirements. Extending the length of the activity would also result in additional operational costs due to increased fuel consumption.

In summary, the operational community determined that implementing procedural mitigation for explosive bombs beyond what is detailed in Table 5.3-11 would be incompatible with the practicality assessment criteria for safety, sustainability, and mission requirements.

5.3.3.6 Sinking Exercises

The Navy will continue to implement procedural mitigation to avoid or reduce potential impacts on marine mammals and sea turtles during sinking exercises, as outlined in Table 5.3-12. In Phase II, the mitigation zone was based on net explosive weight and the associated average ranges to PTS. When developing Phase III mitigation, the Navy analyzed the potential for increasing the size of the mitigation zone. The Navy determined that the current mitigation zone for sinking exercises is the largest area within which it is practical to implement mitigation; therefore, it will continue implementing this same mitigation zone for Phase III.

The Navy is clarifying that it will require observation of the mitigation zone prior to the initial start of the activity to ensure the area is clear of applicable biological resources. The Navy has always verified that the mitigation zone is visually clear prior to conducting explosive activities and is more clearly capturing this current practice in the mitigation measures for Phase III. The Navy is adding a requirement that additional platforms already participating in the activity will support observing the mitigation zone before, during, and after the activity while performing their regular duties. Sinking exercises typically involved multiple participating platforms. When available, having additional personnel support observations of the mitigation zone will help increase the likelihood of detecting biological resources. The 2-hour post-activity observations for sinking exercises are a continuation from Phase II and will help the Navy determine if any resources were injured during the activity. Sinking exercises are scheduled to ensure they are conducted only in daylight hours. The Navy will be able to complete the full 2-hours of post-activity observation during typical activity conditions and it is unlikely that observations will be shortened due to nightfall. The Navy will follow the incident reporting procedures outlined in Section 5.1.2.2.3 (Incident Reports) if an incident is detected at any time during the event, including during the post-activity observations.

Table 5.3-12: Procedural Mitigation for Sinking Exercises

Procedural Mitigation Description
Stressor or Activity • Sinking exercises
Resource Protection Focus • Marine mammals • Sea turtles
Number of Lookouts and Observation Platform • 2 Lookouts (one positioned in an aircraft and one on a vessel) • If additional platforms are participating in the activity, personnel positioned in those assets (e.g., safety observers, evaluators) will support observing the mitigation zone for applicable biological resources while performing their regular duties.
Mitigation Requirements • Mitigation zone: – 2.5 NM around the target ship hulk • Prior to the initial start of the activity (90 min. prior to the first firing): – Conduct aerial observations of the mitigation zone for floating vegetation; delay the start until the mitigation zone is clear. – Conduct aerial observations of the mitigation zone for marine mammals, sea turtles, and jellyfish aggregations; if observed, delay the start of firing. • During the activity: – Conduct passive acoustic monitoring for marine mammals; use information from detections to assist visual observations. – Visually observe the mitigation zone for marine mammals and sea turtles from the vessel; if observed, cease firing. – Immediately after any planned or unplanned breaks in weapons firing of longer than 2 hours, observe the mitigation zone for marine mammals and sea turtles from the aircraft and vessel; if observed, delay recommencement of firing. • Commencement/recommencement conditions after a marine mammal or sea turtle sighting before or during the activity: – The Navy will allow a sighted marine mammal or sea turtle to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following conditions has been met: (1) the animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the target ship hulk; or (3) the mitigation zone has been clear from any additional sightings for 30 min. • After completion of the activity (for 2 hours after sinking the vessel or until sunset, whichever comes first): – Observe the vicinity of where detonations occurred; if any injured or dead marine mammals or ESA-listed species are observed, follow established incident reporting procedures. – If additional platforms are supporting this activity (e.g., providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

There is a chance that animals could enter the mitigation zone after the aircraft conducts its close-range mitigation zone observations and before firing begins (once the aircraft has transited to its distant firing position). The Lookout positioned on the vessel will have a higher likelihood of detecting individual marine mammals and sea turtles that are in the central portion of the mitigation zone near the target ship hulk. Near the perimeter of the mitigation zone, the Lookout will be more likely to detect large visual cues (e.g., whale blows or large pods of dolphins) than individual marine mammals, cryptic marine mammal species, and sea turtles. The Lookout positioned in the aircraft will be able to assist the vessel-based Lookout by observing the entire mitigation zone, including near the perimeter, because the aircraft will be able to transit a larger area more quickly (e.g., during range clearance), and will offer a better vantage point. As described in Chapter 3.8 (Reptiles), some species of sea turtles forage on jellyfish in the region where this activity occurs. Observing for indicators of marine mammal and sea turtle presence will further help avoid or reduce potential impacts on these resources within the mitigation zone.

Bin E11 has the longest predicted impact ranges for the types of explosives used during sinking exercises in the Study Area. For the largest explosive in bin E11, the mitigation zone extends beyond the ranges to 50 percent non-auditory injury and 50 percent mortality for sea turtles and marine mammals. The mitigation zone extends beyond the average ranges to PTS for sea turtles and all marine mammal hearing groups except high-frequency cetaceans (the mitigation zone extends into a portion of the average range to PTS for this hearing group). The mitigation zone also extends beyond or into a portion of the average ranges to TTS for sea turtles and marine mammals. Therefore, depending on the species, mitigation will help avoid or reduce all or a portion of the potential for exposure to mortality, non-auditory injury, PTS, and higher levels of TTS for the largest explosives in bin E11. Smaller explosives in bin E11 and explosives in smaller source bins (e.g., E5, E10) have shorter predicted impact ranges; therefore, the mitigation zone will extend further beyond or cover a greater portion of the impact ranges for these explosives.

As described previously, the Phase III mitigation zone is based on the largest area within which it is practical for the Navy to implement mitigation. It is not practical to increase this mitigation zone because observations within the margin of increase would be ineffective unless the Navy allocated additional platforms to the activity to observe for biological resources. The use of additional personnel, aircraft, or vessels would be unsustainable due to increased operational costs and an exceedance of available manpower and resources for this activity. Adding aircraft to observe the mitigation zone could result in airspace conflicts with the event participants. This would either require the aircraft participating in the activity to modify their flights plans (which would reduce activity realism) or force the observing aircraft to position itself a safe distance away from the activity area (which would decrease observation effectiveness). Adding additional platforms to observe the mitigation zone would increase safety risks due to the presence of additional vessels or aircraft within the vicinity of the intended impact location or in the path of explosive projectiles.

Increasing the mitigation zone size would result in a larger area over which firing would need to be ceased in response to a sighting, and therefore would likely increase the number of times that the sinking exercise would be ceased and would extend the length of the activity. These impacts would significantly diminish event realism in a way that would prevent the activity from meeting its intended objectives. Sinking exercises require focused situational awareness of the activity area and continuous coordination of tactics between ship, submarine, and aircraft crews using multiple weapon systems to deliver explosive ordnance to deliberately sink a deactivated vessel. Extending the length of the activity would require aircraft to depart the area to refuel, which would disrupt the ability for platforms to maintain continuous coordination of tactics. If multiple refueling events were required, the length of the activity would be extended by two to five times or more, which would decrease the ability for Lookouts to safely and effectively maintain situational awareness of the activity area and increase safety risks due to increased pilot fatigue and accelerated fatigue-life of aircraft. These types of impacts would reduce the frequency at which participants would be able to fire on the deactivated vessel. Because the activity ends when the ship sinks, firing at a decreased frequency would ultimately extend the amount of time it takes for the deactivated vessel to sink. Sinking exercises only take place during daylight hours; therefore, the training exercise would likely be delayed into the next day or next several days, which would significantly impact the schedules of the multiple participants. An increase in mitigation would impede the ability for the participants to become proficient in using their weapons as required during military missions and combat operations and would prevent units from meeting their individual training and certification requirements (which would prevent them from deploying with the required level of readiness necessary to accomplish their missions). Extending the length of the activity would also result in additional operational costs due to increased fuel consumption.

In summary, the operational community determined that implementing procedural mitigation for sinking exercises beyond what is detailed in Table 5.3-12 would be incompatible with the practicality assessment criteria for safety, sustainability, and mission requirements.

5.3.3.7 Explosive Mine Countermeasure and Neutralization Activities

The Navy will continue to implement procedural mitigation to avoid or reduce potential impacts on marine mammals and sea turtles from explosive mine countermeasure and neutralization activities, as outlined in Table 5.3-13. The mitigation applies to explosive mine countermeasure and neutralization activities except those that involve the use of Navy divers, which are discussed in Section 5.3.3.8 (Explosive Mine Neutralization Activities Involving Navy Divers). In addition to procedural mitigation, the Navy will implement mitigation for explosive mine countermeasure and neutralization activities within mitigation areas (see Section 5.4.1, Mitigation Areas for Seafloor Resources; Section 5.4.2, Mitigation Areas off the Northeastern United States; and Section 5.4.3, Mitigation Areas off the Mid-Atlantic and Southeastern United States).

The types of charges used in these activities are positively controlled, which means the detonation is controlled by the personnel conducting the activity and is not authorized until the mitigation zone is clear at the time of detonation. In Phase II, explosive mine countermeasure and neutralization activity mitigation zones were based on net explosive weight and the associated average ranges to PTS. When developing Phase III mitigation, the Navy analyzed the potential for increasing the size of the mitigation zones. The Navy identified an opportunity to increase the mitigation zone sizes for bins E5 through E10 to enhance protections to the maximum extent practicable. This increase is reflected in Table 5.3-13. The mitigation zones for explosive mine countermeasure and neutralization activities are now based on the largest areas within which it is practical to implement mitigation. The post-activity observations are a continuation from Phase II and will help the Navy determine if any resources were injured during the activity. The Navy will follow the incident reporting procedures outlined in Section 5.1.2.2.3 (Incident Reports) if an incident is detected at any time during the event, including during the post-activity observations.

The Navy is clarifying that it will require observation of the mitigation zone prior to the initial start of the activity to ensure the area is clear of applicable biological resources. The Navy has always verified that the mitigation zone is visually clear prior to conducting explosive activities and is more clearly capturing this current practice in the mitigation measures for Phase III. The Navy is adding a requirement that additional platforms already participating in the activity will support observing the mitigation zone before, during, and after the activity while performing their regular duties. When available, having additional personnel support observations of the mitigation zone will help increase the likelihood of detecting biological resources.

For the 600-yd. mitigation zone, the small observation area and proximity to the observation platform will result in a high likelihood that the Lookout will be able to detect marine mammals and sea turtles throughout the mitigation zone (regardless of the type of observation platform used). For the 2,100-yd. mitigation zone, the Lookout on a small boat will be more likely to detect large visual cues (e.g., whale blows or large pods of dolphins) or splashes of individual marine mammals than cryptic marine mammal species and sea turtles near the mitigation zone perimeter, while the Lookout positioned in an aircraft will help increase the chance that marine mammals and sea turtles will be detected throughout the mitigation zone. Observing for indicators of marine mammal and sea turtle presence will further help avoid or reduce potential impacts on these resources within the mitigation zones.

Table 5.3-13: Procedural Mitigation for Explosive Mine Countermeasure and Neutralization Activities

Procedural Mitigation Description
Stressor or Activity • Explosive mine countermeasure and neutralization activities
Resource Protection Focus • Marine mammals • Sea turtles
Number of Lookouts and Observation Platform • 1 Lookout positioned on a vessel or in an aircraft when implementing the smaller mitigation zone • 2 Lookouts (one positioned in an aircraft and one on a small boat) when implementing the larger mitigation zone • If additional platforms are participating in the activity, personnel positioned in those assets (e.g., safety observers, evaluators) will support observing the mitigation zone for applicable biological resources while performing their regular duties.

Mitigation Requirements
• Mitigation zones:
  – 600 yd. around the detonation site for activities using 0.1–5-lb. net explosive weight
  – 2,100 yd. around the detonation site for activities using 6–650 lb. net explosive weight (including high explosive target mines)
• Prior to the initial start of the activity (e.g., when maneuvering on station; typically, 10 min. when the activity involves aircraft that have fuel constraints, or 30 min. when the activity involves aircraft that are not typically fuel constrained):
  – Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear.
  – Observe the mitigation zone for marine mammals and sea turtles; if observed, relocate or delay the start of detonations.
• During the activity:
  – Observe the mitigation zone for marine mammals and sea turtles; if observed, cease detonations.
• Commencement/recommencement conditions after a marine mammal or sea turtle sighting before or during the activity:
  – The Navy will allow a sighted marine mammal or sea turtle to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing detonations) until one of the following conditions has been met: (1) the animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to detonation site; or (3) the mitigation zone has been clear from any additional sightings for 10 min. when the activity involves aircraft that have fuel constraints, or 30 min. when the activity involves aircraft that are not typically fuel constrained.
• After completion of the activity (typically 10 min. when the activity involves aircraft that have fuel constraints, or 30 min. when the activity involves aircraft that are not typically fuel constrained):
  – Observe the vicinity of where detonations occurred; if any injured or dead marine mammals or ESA-listed species are observed, follow established incident reporting procedures.
  – If additional platforms are supporting this activity (e.g., providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

Bin E11 (e.g., 650-lb. high explosive target mines) has the longest predicted impact ranges for explosives that apply to the 2,100-yd. mitigation zone. Bin E4 (e.g., 5-lb. net explosive weight charges) has the longest predicted impact ranges for explosives that apply to the 600-yd. mitigation zone. The 2,100-yd. and 600-yd. mitigation zones extend beyond the respective ranges to 50 percent non-auditory injury and 50 percent mortality for sea turtles and marine mammals. The mitigation zones extend beyond the respective average ranges to PTS for sea turtles, mid-frequency cetaceans, and sirenians, and into a portion of the average ranges to PTS for high-frequency cetaceans, low-frequency cetaceans, and phocids. The mitigation zones also extend into a portion of the average ranges to TTS for sea turtles and marine mammals. Therefore, depending on the species, mitigation will help avoid or reduce all or a portion of the potential for exposure to mortality, non-auditory injury, PTS, and higher levels of TTS for the largest explosives in bin E11 and bin E4. Smaller explosives within bin E11 and bin E4 and explosives in smaller source bins (e.g., E2) have shorter predicted impact ranges; therefore, the mitigation zones will cover a greater portion of the impact ranges for these explosives.

As described previously, the Phase III mitigation zones are based on the largest areas within which it is practical for the Navy to implement mitigation. It is not practical to increase these mitigation zones because observations within the margin of increase would be unsafe and ineffective unless the Navy allocated additional platforms to the activity to observe for biological resources. The use of additional personnel and equipment (e.g., small boats, aircraft) would be unsustainable due to increased operational costs and an exceedance of available manpower and resources for this activity. Adding aircraft to observe the mitigation zone could result in airspace conflicts with the event participants. This would either require the aircraft conducting the activity to modify their flights plans (which would reduce activity realism) or force the observing aircraft to position itself a safe distance away from the activity area (which would decrease observation effectiveness). Adding vessels to observe the mitigation zone would increase safety risks due to the presence observation vessels within the vicinity of detonations.

Increasing the mitigation zone sizes would result in larger areas over which firing would need to be ceased in response to a sighting, and therefore would likely increase the number of times detonations would be ceased and would extend the length of the activity. These impacts would significantly diminish realism in a way that would prevent the activity from meeting its intended objectives. For example, Mine Countermeasures – Mine Neutralization – Remotely Operated Vehicle training exercises require focused situational awareness of the activity area and continuous coordination of tactics between ship, small boat, and rotary-wing aircraft crews to locate and neutralize mines. During Airborne Mine Neutralization Systems Test events, personnel evaluate the system's ability to detect and destroy mines from an airborne mine countermeasures-capable rotary-wing aircraft in advance of delivery to the fleet for operational use. Extending the length of these activities would require aircraft to depart the activity area to refuel. If multiple refueling events were required, the length of the activity would be extended by two to five times or more. This would decrease the ability for Lookouts to safely and effectively maintain situational awareness of the activity area and would increase safety risks due to increased pilot fatigue and accelerated fatigue-life of aircraft.

These types of impacts would result in a significant loss of training or testing time (which would reduce the number of opportunities that platforms have to locate and neutralize mines and reduce the Navy's ability to validate whether mine neutralization systems perform as expected) and cause a significant delay to the training or testing schedule. Therefore, an increase in mitigation would impede the ability for the Navy to train and become proficient in using mine neutralization systems as required during military missions and combat operations, would prevent units from meeting their individual training and certification requirements (which would prevent them from deploying with the required level of readiness necessary to accomplish their missions), and would impede the ability of program managers and weapons system acquisition programs to meet testing requirements per required acquisition milestones or on an as-needed basis to meet operational requirements. Extending the length of the activities would also result in additional operational costs due to increased fuel consumption.

In summary, the operational community determined that implementing procedural mitigation for explosive mine countermeasure and neutralization activities beyond what is detailed in Table 5.3-13 would be incompatible with the practicality assessment criteria for safety, sustainability, and mission requirements.

5.3.3.8 Explosive Mine Neutralization Activities Involving Navy Divers

The Navy will continue to implement procedural mitigation to avoid or reduce potential impacts on marine mammals and sea turtles from explosive mine neutralization activities involving Navy divers, as outlined in Table 5.3-14. Navy divers participating in these activities may be explosive ordnance disposal personnel. In addition to procedural mitigation, the Navy will implement mitigation for these activities within mitigation areas (see Section 5.4.1, Mitigation Areas for Seafloor Resources; Section 5.4.2, Mitigation Areas off the Northeastern United States; and Section 5.4.3, Mitigation Areas off the Mid-Atlantic and Southeastern United States).

Table 5.3-14: Procedural Mitigation for Explosive Mine Neutralization Activities Involving Navy Divers

Procedural Mitigation Description
Stressor or Activity • Explosive mine neutralization activities involving Navy divers
Resource Protection Focus • Marine mammals • Sea turtles
Number of Lookouts and Observation Platform • 2 Lookouts (two small boats with one Lookout each, or one Lookout on a small boat and one in a rotary-wing aircraft) when implementing the smaller mitigation zone • 4 Lookouts (two small boats with two Lookouts each), and a pilot or member of an aircrew will serve as an additional Lookout if aircraft are used during the activity, when implementing the larger mitigation zone • All divers placing the charges on mines will support the Lookouts while performing their regular duties and will report applicable sightings to their supporting small boat or Range Safety Officer. • If additional platforms are participating in the activity, personnel positioned in those assets (e.g., safety observers, evaluators) will support observing the mitigation zone for applicable biological resources while performing their regular duties.
Mitigation Requirements • Mitigation zones: – 500 yd. around the detonation site during activities under positive control using 0.1–20 lb. net explosive weight – 1,000 yd. around the detonation site during activities using time-delay fuses (0.1–20 lb. net explosive weight) and during activities under positive control using 21–60 lb. net explosive weight charges • Prior to the initial start of the activity (e.g., when maneuvering on station for activities under positive control; 30 min. for activities using time-delay firing devices): – Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear. – Observe the mitigation zone for marine mammals and sea turtles; if observed, relocate or delay the start of detonations or fuse initiation. • During the activity: – Observe the mitigation zone for marine mammals and sea turtles; if observed, cease detonations or fuse initiation. – To the maximum extent practicable depending on mission requirements, safety, and environmental conditions, boats will position themselves near the mid-point of the mitigation zone radius (but outside of the detonation plume and human safety zone), will position themselves on opposite sides of the detonation location (when two boats are used), and will travel in a circular pattern around the detonation location with one Lookout observing inward toward the detonation site and the other observing outward toward the perimeter of the mitigation zone. – If used, aircraft will travel in a circular pattern around the detonation location to the maximum extent practicable. – The Navy will not set time-delay firing devices (0.1–20 lb. net explosive weight) to exceed 10 min. • Commencement/recommencement conditions after a marine mammal or sea turtle sighting before or during the activity: – The Navy will allow a sighted marine mammal or sea turtle to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing detonations) until one of the following conditions has been met: (1) the animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the detonation site; or (3) the mitigation zone has been clear from any additional sightings for 10 min. during activities under positive control with aircraft that have fuel constraints, or 30 min. during activities under positive control with aircraft that are not typically fuel constrained and during activities using time-delay firing devices. • After completion of an activity (for 30 min): – Observe the vicinity of where detonations occurred; if any injured or dead marine mammals or ESA-listed species are observed, follow established incident reporting procedures. – If additional platforms are supporting this activity (e.g., providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

In Phase II, the mitigation zones for explosive mine neutralization activities involving Navy divers were based on net explosive weight and the associated average ranges to PTS. When developing Phase III mitigation, the Navy analyzed the potential for increasing the size of the mitigation zones. The Navy identified an opportunity to increase the mitigation zone size for positive control charges in bin E4 or below and bin E7 to enhance protections to the maximum extent practicable and for consistency across activities. These increases are reflected in Table 5.3-14. The mitigation zones for explosive mine neutralization activities involving the use of Navy divers are now based on the largest areas within which it is practical to implement mitigation. The post-activity observations are a continuation from Phase II and will help the Navy determine if any resources were injured during the activity. The Navy will follow the incident reporting procedures outlined in Section 5.1.2.2.3 (Incident Reports) if an incident is detected at any time during the event, including during the post-activity observations.

The Navy is clarifying that it will require observation of the mitigation zone prior to the initial start of the activity to ensure the area is clear of applicable biological resources. The Navy has always verified that the mitigation zone is visually clear prior to conducting explosive activities and is more clearly capturing this current practice in the mitigation measures for Phase III. The Navy is adding a requirement that additional platforms already participating in the activity will support observing the mitigation zone before, during, and after the activity while performing their regular duties. When available, having additional personnel support observations of the mitigation zone will help increase the likelihood of detecting biological resources.

The charges used during explosive mine neutralization activities involving Navy divers are either positively controlled or initiated using a time-delay fuse. Positive control means the detonation is controlled by the personnel conducting the activity and is not authorized until the area is clear at the time of detonation. Time-delay means the detonation is fused with a specified time-delay by the personnel conducting the activity and is not authorized until the area is clear at the time the fuse is initiated but cannot be terminated once the fuse is initiated due to human safety concerns. For activities using a time-delay fuse, there is a remote chance that animals could swim into the mitigation zone after the fuse has been initiated. The Navy established a mitigation measure to set time-delay firing devices not to exceed 10-min. to limit the potential time that animals have to swim into the mitigation zone after fuse initiation. During activities under positive control, the Navy can cease detonations at any time in response to a sighting of a marine mammal or sea turtle. For this reason, all activities using a time-delay fuse will implement the 1,000-yd. mitigation zone, while activities that are under positive control will implement either the 500-yd. or 1,000-yd. mitigation zone, depending on the size of the charge. Time-delay charges have a maximum charge size of 20-lb. net explosive weight.

For the 500-yd. mitigation zone, the small observation area and proximity to observation platforms will result in a high likelihood that Lookouts will be able to detect marine mammals and sea turtles throughout the mitigation zone. For the 1,000-yd. mitigation zone, the use of two additional Lookouts increases the likelihood that Lookouts will be able to detect marine mammals and sea turtles across the larger observation area. Due to their low vantage point on the water, Lookouts in small boats will be more likely to detect large visual cues (e.g., whale blows or large pods of dolphins) or the splashes of individual marine mammals than cryptic marine mammal species and sea turtles near the perimeter of the 1,000-yd. mitigation zone. When rotary-wing aircraft are used, Lookouts positioned in an aircraft will have a good vantage point for observing out to the perimeter of the 500-yd. and 1,000-yd. mitigation zones. Observing for indicators of marine mammal and sea turtle presence will further help avoid or reduce potential impacts on these resources within the mitigation zones.

Bin E7 (e.g., 60-lb. net explosive weight charges) and bin E6 (e.g., 20-lb. net explosive weight) have the longest predicted impact ranges for positive control explosives and time-delay explosives that apply to the 1,000-yd. mitigation zone, respectively. Bin E6 (e.g., 20-lb. net explosive weight) has the longest predicted impact ranges for the positive control explosives that apply to the 500-yd. mitigation zone. The 1,000-yd. and 500-yd. mitigation zones extend beyond the respective ranges to 50 percent non-auditory injury and 50 percent mortality for sea turtles and marine mammals. For time-delay charges, the 1,000-yd. mitigation zone extends beyond the average ranges to PTS for sea turtles and marine mammals that could potentially occur in the locations where this activity takes place (high-frequency cetaceans and phocids are unlikely to occur in the areas where these activities take place). For positive control charges, the 1,000-yd. and 500-yd. mitigation zones extend beyond the average ranges to PTS for sea turtles and marine mammals that could potentially occur in the locations where this activity takes place except low-frequency cetaceans (the mitigation zones extend into a portion of the average ranges to PTS for this hearing group). The mitigation zones also extend into a portion of the average ranges to TTS for sea turtles and marine mammals. Therefore, depending on the species, mitigation will help avoid or reduce all or a portion of the potential for exposure to mortality, non-auditory injury, PTS, and higher levels of TTS for the largest explosives in bin E7 and bin E6. Smaller explosives within bin E7 and bin E6 and explosives in smaller source bins (e.g., E5) have shorter predicted impact ranges; therefore, the mitigation zones will cover a greater portion of the impact ranges for these explosives.

As described previously, the Phase III mitigation zones are based on the largest areas within which it is practical for the Navy to implement mitigation. It is not practical to increase these mitigation zones because observations within the margin of increase would be unsafe and ineffective unless the Navy allocated additional platforms to the activity to observe for biological resources. Because mine neutralization activities involve training Navy divers in the safe handling of explosive charges, one of the mission-essential safety protocols required of all event participants, including Lookouts, is to maintain focus on the activity area to ensure safety of personnel and equipment. The typical mine neutralization activity areas coincide with the mitigation zone sizes developed for Phase III; therefore, Lookouts can safely and effectively observe the mitigation zones for biological resources while simultaneously maintaining focus on the activity areas. However, if the mitigation zone sizes increased, Lookouts would need to redirect their attention beyond the activity areas. This would not meet the safety criteria since personnel would be required to direct their attention away from mission requirements. Alternatively, the Navy would need to add personnel to serve as additional Lookouts on the existing observation platforms or allocate additional platforms to the activity to observe for biological resources. These actions would not be safe or sustainable due to an exceedance of manpower, resource, and space restrictions for these activities.

Increasing the mitigation zone sizes would result in larger areas over which detonations would need to be ceased in response to a sighting, and therefore would likely increase the number of times detonations would be ceased. This would extend the length of the activities and cause significant safety risks for Navy divers and loss of training time. Ceasing an activity (e.g., fuse initiation) with divers in the water would have safety implications for diver air consumption and bottom time. It would also impede the ability for Navy divers to complete the training exercise with the focused endurance as required during military missions and combat operations. These impacts would significantly diminish event realism in a way that would prevent activities from meeting their intended objectives. For example, the number of opportunities that divers would have to locate and neutralize mines would be reduced. Divers would then not be able to gain skill proficiency in precise identification and evaluation of a threat mine, safe handling of explosive material during charge placement, and effective charge detonation or fuse initiation. Mine neutralization activities involving the use of Navy divers only take place during daylight hours for safety reasons; therefore, extending the length of the activity could delay the activity into the next day or next several days, which would significantly impact training schedules for all participating platforms. Therefore, an increase in mitigation would impede the ability for Navy divers to train and become proficient in mine neutralization and would prevent units from meeting their individual training and certification requirements (which would prevent them from deploying with the required level of readiness necessary to accomplish their missions).

For activities that involve aircraft, extending the length of the activity would require aircraft to depart the area to refuel. If multiple refueling events were required, the length of the activity would be extended by two to five times or more, which would decrease the ability for Lookouts to safely and effectively maintain situational awareness of the activity area and increase safety risks due to increased pilot fatigue and accelerated fatigue-life of aircraft. Extending the length of the activity would also result in additional operational costs due to increased fuel consumption.

In summary, the operational community determined that implementing procedural mitigation for explosive mine neutralization activities involving Navy divers beyond what is detailed in Table 5.3-14 would be incompatible with the practicality assessment criteria for safety, sustainability, and mission requirements.

5.3.3.9 Maritime Security Operations – Anti-Swimmer Grenades

The Navy will continue to implement procedural mitigation to avoid or reduce potential impacts on marine mammals and sea turtles from anti-swimmer grenades during Maritime Security Operations, as outlined in Table 5.3-15. In addition to procedural mitigation, the Navy will implement mitigation for in-water detonations within mitigation areas (see Section 5.4.2, Mitigation Areas off the Northeastern United States; Section 5.4.3, Mitigation Areas off the Mid-Atlantic and Southeastern United States; and Section 5.4.4, Mitigation Areas in the Gulf of Mexico).

In Phase II, the Maritime Security Operations – Anti-Swimmer Grenade mitigation zone was based on net explosive weight and the associated average ranges to PTS. When developing Phase III mitigation, the Navy analyzed the potential for increasing the size of the mitigation zone. The Navy determined that the current mitigation zone is the largest area within which it is practical to implement mitigation for this activity; therefore, it will continue implementing this same mitigation zone for Phase III.

The Navy is clarifying that it will require observation of the mitigation zone prior to the initial start of the activity to ensure the area is clear of applicable biological resources. The Navy has always verified that the mitigation zone is visually clear prior to conducting explosive activities and is more clearly capturing this current practice in the mitigation measures for Phase III. The Navy developed a new mitigation measure requiring the Lookout to observe the mitigation zone after completion of the activity. The Navy currently conducts post-activity observations for some, but not all explosive activities. In developing mitigation for Phase III, the Navy determined that it could expand this requirement to other explosive activities for enhanced consistency and to help determine if any resources were injured during explosive events, when practical. The Navy is adding a requirement that additional platforms already participating in the activity will support observing the mitigation zone before, during, and after the activity while performing their regular duties. When available, having additional personnel support observations of the mitigation zone will help increase the likelihood of detecting biological resources. The Navy will follow the incident reporting procedures outlined in Section 5.1.2.2.3 (Incident Reports) if an incident is detected at any time during the event, including during the post-activity observations.

Table 5.3-15: Procedural Mitigation for Maritime Security Operations – Anti-Swimmer Grenades

Procedural Mitigation Description
Stressor or Activity • Maritime Security Operations – Anti-Swimmer Grenades
Resource Protection Focus • Marine mammals • Sea turtles
Number of Lookouts and Observation Platform • 1 Lookout positioned on the small boat conducting the activity • If additional platforms are participating in the activity, personnel positioned in those assets (e.g., safety observers, evaluators) will support observing the mitigation zone for applicable biological resources while performing their regular duties.
Mitigation Requirements • Mitigation zone: – 200 yd. around the intended detonation location • Prior to the initial start of the activity (e.g., when maneuvering on station): – Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear. – Observe the mitigation zone for marine mammals and sea turtles; if observed, relocate or delay the start of detonations. • During the activity: – Observe the mitigation zone for marine mammals and sea turtles; if observed, cease detonations. • Commencement/recommencement conditions after a marine mammal or sea turtle sighting before or during the activity: – The Navy will allow a sighted marine mammal or sea turtle to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing detonations) until one of the following conditions has been met: (1) the animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended detonation location; (3) the mitigation zone has been clear from any additional sightings for 30 min.; or (4) the intended detonation location has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting. • After completion of the activity (e.g., prior to maneuvering off station): – When practical (e.g., when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), observe the vicinity of where detonations occurred; if any injured or dead marine mammals or ESA-listed species are observed, follow established incident reporting procedures. – If additional platforms are supporting this activity (e.g., providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

The small mitigation zone size and proximity to the observation platform result in a high likelihood that Lookouts will be able to detect marine mammals and sea turtles throughout the mitigation zone. Observing for indicators of marine mammal and sea turtle presence will further help avoid or reduce potential impacts on these resources within the mitigation zone.

Explosives used during Maritime Security Operations – Anti-Swimmer Grenades exercises are in bin E2 (e.g., 0.5-lb. net explosive weight). The mitigation zone extends beyond the ranges to 50 percent non-auditory injury and 50 percent mortality for sea turtles and marine mammals. The mitigation zone extends beyond the respective average ranges to PTS for sea turtles all marine mammal hearing groups that could potentially occur in the locations where this activity takes place (high-frequency cetaceans are unlikely to occur in the areas where this activity takes place). The mitigation zone also extends into a portion of the average ranges to TTS for sea turtles and marine mammals. Therefore, mitigation will help avoid or reduce all or a portion of the potential for exposure to mortality, non-auditory injury, PTS, and higher levels of TTS for the largest explosives in bin E2.

As described previously, the Phase III mitigation zone is based on the largest area within which it is practical for the Navy to implement mitigation. It is not practical to increase the mitigation zone because observations within the margin of increase would be unsafe and ineffective. Because this activity involves training crews in the safe handling of explosive hand grenades, one of the mission-essential safety protocols required of all event participants, including the Lookout, is to maintain focus on the activity area to ensure safety of personnel and equipment. The typical activity area coincides with the mitigation zone that will be implemented for Phase III; therefore, Lookouts can safely and effectively observe the mitigation zone for biological resources while simultaneously maintaining focus on the activity area. However, if the mitigation zone size increased, the Lookout would need to redirect attention to observe beyond the activity area. This would not meet the safety criteria since personnel would be required to direct their attention away from mission requirements. Alternatively, the Navy would need to either add personnel to serve as additional Lookouts on the existing observation platform or allocate additional platforms to the activity to observe for biological resources. These actions would not be safe or sustainable due an exceedance of manpower, resource, and space restrictions for this activity.

In summary, the operational community determined that implementing procedural mitigation for Maritime Security Operations – Anti-Swimmer Grenades beyond what is detailed in Table 5.3-15 would be incompatible with the practicality assessment criteria for safety and sustainability.

5.3.3.10 Line Charge Testing

The Navy will continue to implement procedural mitigation to avoid or reduce potential impacts on marine mammals, sea turtles, and fish (ESA-listed Gulf sturgeon) from line charge testing, as outlined in Table 5.3-16. In Phase II, the line charge testing mitigation zone was based on net explosive weight and the associated average ranges to PTS. When developing Phase III mitigation, the Navy analyzed the potential for increasing the size of the mitigation zone. The Navy determined that the current mitigation zone is the largest area within which it is practical to implement mitigation for this activity; therefore, it will continue implementing this same mitigation zone for Phase III.

The Navy is clarifying that it will require observation of the mitigation zone prior to the initial start of the activity to ensure the area is clear of applicable biological resources. The Navy has always verified that the mitigation zone is visually clear prior to conducting explosive activities and is more clearly capturing this current practice in the mitigation measures for Phase III. The Navy developed a new mitigation measure requiring the Lookout to observe the mitigation zone after completion of the activity. The Navy currently conducts post-activity observations for some, but not all explosive activities. In developing mitigation for Phase III, the Navy determined that it could expand this requirement to other explosive activities for enhanced consistency and to help determine if any resources were injured during explosive events, when practical. The Navy is adding a requirement that additional platforms already participating in the activity will support observing the mitigation zone before, during, and after the activity while performing their regular duties. When available, having additional personnel support observations of the mitigation zone will help increase the likelihood of detecting biological resources. The Navy will follow the incident reporting procedures outlined in Section 5.1.2.2.3 (Incident Reports) if an incident is detected at any time during the event, including during the post-activity observations.

Naval Surface Warfare Center, Panama City Division Testing Range is currently the Navy's only location capable of supporting this type of activity. Mitigation to not conduct line charge testing at night from March through September will help avoid or reduce potential impacts on green, Kemp's ridley, loggerhead, and leatherback sea turtles during the time of day when they would be most likely to transit to and from their nesting beaches during nesting season. Mitigation to not conduct line charge testing activities from October through March (except within a designated location on Santa Rosa Island) will help avoid or reduce potential impacts on ESA-listed Gulf sturgeon during their seasonal migration from the Gulf of Mexico winter and feeding grounds to the spring and summer natal (hatching) rivers (the Yellow, Choctawhatchee, and Apalachicola Rivers).

Table 5.3-16: Procedural Mitigation for Line Charge Testing

Procedural Mitigation Description
<u>Stressor or Activity</u> • Line charge testing
<u>Resource Protection Focus</u> • Marine mammals • Sea turtles • Fish (Gulf sturgeon)
<u>Number of Lookouts and Observation Platform</u> • 1 Lookout positioned on a vessel • If additional platforms are participating in the activity, personnel positioned in those assets (e.g., safety observers, evaluators) will support observing the mitigation zone for applicable biological resources while performing their regular duties.

<u>Mitigation Requirements</u>
• Mitigation zone:
  – 900 yd. around the intended detonation location
• Prior to the initial start of the activity (e.g., when maneuvering on station):
  – Observe the mitigation zone for floating vegetation; if observed, delay the start until the mitigation zone is clear.
  – Observe the mitigation zone for marine mammals and sea turtles; if observed, delay the start of detonations.
• During the activity:
  – Observe the mitigation zone for marine mammals and sea turtles; if observed, cease detonations.
• Commencement/recommencement conditions after a marine mammal or sea turtle sighting before or during the activity:
  – The Navy will allow a sighted marine mammal or sea turtle to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing detonations) until one of the following conditions has been met: (1) the animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended detonation location; or (3) the mitigation zone has been clear from any additional sightings for 30 min.
• After completion of the activity (e.g., prior to maneuvering off station):
  – When practical (e.g., when platforms are not constrained by fuel restrictions or mission-essential follow-on commitments), observe the vicinity of where detonations occurred; if any injured or dead marine mammals or ESA-listed species are observed, follow established incident reporting procedures.
  – If additional platforms are supporting this activity (e.g., providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.
• Additional requirements:
  – From March through September (sea turtle nesting season), the Navy will not conduct line charge testing at night.
  – From October through March (Gulf sturgeon migration season), Navy will not conduct line charge testing except within a designated location on Santa Rosa Island.

During line charge testing, surface vessels deploy line charges to test the capability to safely clear surf zone areas for sea-based expeditionary forces. Line charges consist of a 350-ft. detonation cord with explosives lined from one end to the other end in a series of 5-lb. increments. Lookouts will have a better likelihood of detecting individual marine mammals and sea turtles that are in the near-range or central portion of the mitigation zone. Lookouts will be more likely to detect large visual cues (e.g., whale blows or large pods of dolphins) or the splashes of individual marine mammals than cryptic marine mammal species and sea turtles near the perimeter of the mitigation zone (e.g., near the shoreline). Observing for indicators of marine mammal and sea turtle presence will further help avoid or reduce potential impacts on these resources within the mitigation zones.

Bin E14 (2,500-lb. high blast explosive) is the largest explosive used in line charge testing. Mitigation will likely help avoid or reduce all or a portion of the potential for exposure to mortality, non-auditory injury, PTS, and higher levels of TTS during line charge testing.

As described previously, the Phase III mitigation zone is based on the largest area within which it is practical for the Navy to implement mitigation. It is not practical to increase the mitigation zone because observations within the margin of increase would be unsafe and ineffective unless the Navy allocated additional platforms to the activity to observe for biological resources. The use of additional personnel and equipment (e.g., vessels) would be unsustainable due to increased operational costs and an exceedance of the available manpower and resources for this activity. Adding vessels to observe the mitigation zone would increase safety risks due to the presence of observation vessels within the vicinity of an explosive line charge.

Increasing the mitigation zone would result in a larger area over which detonations would need to be ceased in response to a sighting, and therefore would likely increase the number of times detonations would be ceased. This would extend the length of the activity and significantly diminish realism in a way that would prevent the activity from meeting its intended objectives. For example, ceasing a detonation during the event would mean that the Navy would not be able to test the explosive array continuously from one end to the other, which would impede the ability for surface vessels to effectively test the capability of the line charges to neutralize mine threats and clear surf zone areas for sea-based expeditionary forces as required during military missions and combat operations, and to meet testing requirements per required acquisition milestones or on an as-needed basis to meet operational requirements. Line charge testing only takes place during daylight hours from March through September as mitigation for sea turtle nesting; therefore, extending the length of the activity would result in a delay into the next day or next several days during that season, which would significantly impact the testing schedules of all event participants.

In summary, the operational community determined that implementing procedural mitigation for line charge testing beyond what is detailed in Table 5.3-16 would be incompatible with the practicality assessment criteria for safety, sustainability and mission requirements.

5.3.3.11 Ship Shock Trials

The Navy will continue to implement procedural mitigation to avoid or reduce potential impacts on marine mammals and sea turtles to from ship shock trials, as outlined in Table 5.3-17. The Navy will continue to provide detailed ship shock trial mitigation to NMFS for review and approval approximately 1 year prior to each event. In Phase II, the ship shock trial mitigation zone was based on net explosive weight and the associated average ranges to PTS. When developing Phase III mitigation, the Navy analyzed the potential for increasing the size of this mitigation zone. The Navy determined that the current mitigation zone for ship shock trials is the largest area within which it is practical to implement mitigation for this activity; therefore, it will continue implementing this same mitigation zone for Phase III. The post-activity observations are a continuation from Phase II and will help the Navy determine if any resources were injured during the activity. The Navy will follow the incident reporting procedures outlined in Section 5.1.2.2.3 (Incident Reports) if an incident is detected at any time during the event, including during the post-activity observations.

The Navy is clarifying that it will require observation of the mitigation zone prior to the initial start of the activity to ensure the area is clear of applicable biological resources. The Navy has always verified that the mitigation zone is visually clear prior to conducting explosive activities and is more clearly capturing this current practice in the mitigation measures for Phase III. The Navy is adding a requirement that additional platforms already participating in the activity will support observing the mitigation zone before, during, and after the activity while performing their regular duties. There are typically multiple platforms in the vicinity of ship shock trial activities (e.g., safety aircraft). When available, having additional personnel support observations of the mitigation zone will help increase the likelihood of detecting biological resources.

Table 5.3-17: Procedural Mitigation for Ship Shock Trials

Procedural Mitigation Description
Stressor or Activity • Ship shock trials
Resource Protection Focus • Marine mammals • Sea turtles
Number of Lookouts and Observation Platform • At least 10 Lookouts or trained marine species observers (or a combination thereof) positioned either in an aircraft or on multiple vessels (i.e., a Marine Animal Response Team boat and the test ship) – If aircraft are used, Lookouts or trained marine species observers will be in an aircraft and on multiple vessels – If aircraft are not used, a sufficient number of additional Lookouts or trained marine species observers will be used to provide vessel-based visual observation comparable to that achieved by aerial surveys • If additional platforms are participating in the activity, personnel positioned in those assets (e.g., safety observers, evaluators) will support observing the mitigation zone for applicable biological resources while performing their regular duties.
Mitigation Requirements • Mitigation zone: – 3.5 NM around the ship hull • During event planning: – The Navy will not conduct ship shock trials in the Jacksonville Operating Area during North Atlantic right whale calving season from November 15 through April 15. – The Navy develops detailed ship shock trial monitoring and mitigation plans approximately 1-year prior to an event and will continue to provide these to NMFS for review and approval. – Pre-activity planning will include selection of one primary and two secondary areas where marine mammal populations are expected to be the lowest during the event, with the primary and secondary locations located more than 2 NM from the western boundary of the Gulf Stream for events in the Virginia Capes Range Complex or Jacksonville Range Complex. – If it is determined during pre-activity surveys that the primary area is environmentally unsuitable (e.g., observations of marine mammals or presence of concentrations of floating vegetation), the shock trial could be moved to a secondary site in accordance with the detailed mitigation and monitoring plan provided to NMFS. • Prior to the initial start of the activity at the primary shock trial location (in intervals of 5 hours, 3 hours, 40 min., and immediately before the detonation): – Observe the mitigation zone for floating vegetation; if observed, delay the start until the mitigation zone is clear. – Observe the mitigation zone for marine mammals and sea turtles; if observed, delay triggering the detonation. • During the activity: – Observe the mitigation zone for marine mammals, sea turtles, large schools of fish, jellyfish aggregations, and flocks of seabirds; if observed, cease triggering the detonation. – After completion of each detonation, observe the mitigation zone for marine mammals and sea turtles; if any injured or dead marine mammals or sea turtles are observed, follow established incident reporting procedures and halt any remaining detonations until the Navy can consult with NMFS and review or adapt the mitigation, if necessary. • Commencement/recommencement conditions after a marine mammal or sea turtle sighting before or during the activity: – The Navy will allow a sighted marine mammal or sea turtle to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing detonations) until one of the following conditions has been met: (1) the animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the ship hull; or (3) the mitigation zone has been clear from any additional sightings for 30 min. • After completion of the activity (during the following 2 days at a minimum, and up to 7 days at a maximum): – Observe the vicinity of where detonations occurred; if any injured or dead marine mammals or ESA-listed species are observed, follow established incident reporting procedures. – If additional platforms are supporting this activity (e.g., providing range clearance), these assets will assist in the visual observation of the area where detonations occurred.

Lookouts positioned in aircraft will have the best vantage point for observing the mitigation zone. During small ship shock trials, aerial surveys are not always operationally feasible due to resource limitations; however, if vessels are used as the sole observation platform, the use of additional vessels will ensure that observations of the mitigation zone are comparable to what is achieved when aircraft are used.

The mitigation zone represents the maximum area that would likely be effective at avoiding or reducing impacts on marine mammals and sea turtles during ship shock trials based on the amount of time it takes for vessels and aircraft to patrol the area. The longer a vessel or aircraft spends transiting the survey area, the less focused the survey becomes at observing individuals that may be present close to the detonation location. Even with the intensive observation effort that will be used during ship shock trials, there is a chance that animals could enter the mitigation zone at one end while observation platforms are conducting observations in other locations. Lookouts will have a better likelihood of detecting marine mammals and sea turtles that are in the central portion of the mitigation zone (around the ship hull) and during closer-range observations but are not likely to detect these resources at the far side of the mitigation zone perimeter. At far distances, Lookouts will have a better likelihood of detecting large visual cues (e.g., whale blows or large pods of dolphins) than individual marine mammals, cryptic marine mammal species, and sea turtles. Observing for indicators of marine mammal and sea turtle presence will further help avoid or reduce potential impacts on these resources within the mitigation zone. The Navy will observe for additional marine mammal and sea turtle indicators during this activity (large schools of fish, jellyfish aggregations, and flocks of seabirds) as an added precaution.

Bin E17 has the longest predicted impact ranges for explosives used in ship shock trials in the Study Area. For the largest explosive in bin E17, the mitigation zone extends beyond the ranges to 50 percent non-auditory injury and 50 percent mortality for sea turtles and marine mammals. The mitigation zone extends beyond the average ranges to PTS for sea turtles and all marine mammal hearing groups that could potentially occur in the locations where this activity takes place except high-frequency cetaceans and low-frequency cetaceans (the mitigation zone extends into a portion of the average ranges to PTS for these hearing groups). Phocids and sirenians are unlikely to occur in the areas where this activity takes place. The mitigation zone also extends beyond the average ranges to TTS for mid-frequency cetaceans and into a portion of the average ranges to TTS for sea turtles and other marine mammals. Therefore, mitigation will help avoid or reduce all or a portion of the potential for exposure to mortality, non-auditory injury, PTS, and higher levels of TTS for the largest explosives in bin E17. Smaller explosives in bin E17 and explosives in smaller source bins (e.g., E16) have shorter predicted impact ranges; therefore, the mitigation zone will extend further beyond or cover a greater portion of the impact ranges for these explosives.

As described previously, the Phase III mitigation zone is based on the largest area within which it is practical for the Navy to implement mitigation. It is not practical to increase the mitigation zones because observations within the margin of increase would be unsafe and ineffective unless the Navy allocated additional platforms to the activity to observe for biological resources. The use of additional personnel (Lookouts or trained marine species observers) and equipment (vessels or aircraft) would be unsustainable due to increased operational costs and an exceedance of the available manpower and resources for this activity. Adding aircraft to observe the mitigation zone could result in airspace conflicts with the event participants. This would either require the aircraft conducting the activity to modify their flights plans (which would reduce activity realism) or force the observing aircraft to position itself a safe distance away from the activity area (which would decrease observation effectiveness). Adding vessels to observe the mitigation zone would increase safety risks due to the presence of observation vessels within the vicinity of high blast explosives. Alternatively, vessels would need to position themselves a safe distance from the activity, which would decrease observation effectiveness.

Increasing the mitigation zone would result in a larger area over which detonations would need to be ceased in response to a sighting, and therefore would likely increase the number of times detonations would be ceased. This would extend the length of the activity and significantly diminish realism in a way that would prevent the activity from meeting its intended objectives. Extending the length of the activity would require aircraft to depart the area to refuel. If multiple refueling events were required, the activity length would be extended by two to five times or more, which would decrease the ability for aircraft to safely and effectively maintain situational awareness of the activity area and increase safety risks due to increased pilot fatigue and accelerated fatigue-life of aircraft. Extending the length of the activity would also result in additional operational costs due to increased fuel consumption. Increasing the mitigation would significantly impact the schedules of the participants due to the logistical complexity of event coordination between participating aircraft carriers, support craft, fixed-wing aircraft, and rotary-wing aircraft. These delays would prevent the Navy from meeting testing requirements per required acquisition milestones or on an as-needed basis to meet operational requirements.

In summary, the operational community determined that implementing procedural mitigation for ship shock trials beyond what is detailed in Table 5.3-17 would be incompatible with the practicality assessment criteria for safety, sustainability, and mission requirements.

5.3.4 Physical Disturbance and Strike Stressors

The Navy will implement procedural mitigation to avoid or reduce potential impacts on biological resources from the physical disturbance and strike stressors or activities discussed in the sections below. Section 3.7.3.4 (Physical Disturbance and Strike Stressors) and Section 3.8.3.4 (Physical Disturbance and Strike Stressors) provide a full analysis of the potential impacts of physical disturbance and strikes on marine mammals and sea turtles, respectively. Appendix F (Military Expended Material and Direct Strike Impact Analysis) presents the impact footprints and direct strike calculations.

5.3.4.1 Vessel Movement

The Navy will continue to implement procedural mitigation to avoid or reduce the potential for vessel strikes of marine mammals and sea turtles, as outlined in Table 5.3-18. In addition to procedural mitigation, the Navy will implement mitigation for vessel movement within mitigation areas (see Section 5.4.1, Mitigation Areas for Seafloor Resources; Section 5.4.2, Mitigation Areas off the Northeastern United States; and Section 5.4.3, Mitigation Areas off the Mid-Atlantic and Southeastern United States).

The procedural mitigation measures for vessel movement are based on guidance from NMFS and the USFWS for vessel strike avoidance. When developing Phase III mitigation, the Navy analyzed the potential for implementing additional mitigation. The Navy identified a potential opportunity to develop a new mitigation measure for broadcasting North Atlantic right whale Dynamic Management Area information to Navy assets. The other procedural mitigation measures for vessel movement listed in Table 5.3-18 are a continuation from Phase II. Although the Navy is unable to position Lookouts on unmanned vessels, some vessels that operate autonomously have embedded sensors that aid in avoidance of large objects. The embedded sensors may help those unmanned vessels avoid marine mammal vessel strikes.

Table 5.3-18: Procedural Mitigation for Vessel Movement

Procedural Mitigation Description
Stressor or Activity • Vessel movement – The mitigation will not be applied if: (1) the vessel's safety is threatened, (2) the vessel is restricted in its ability to maneuver (e.g., during launching and recovery of aircraft or landing craft, during towing activities, when mooring, etc.), or (3) the vessel is operated autonomously.
Resource Protection Focus • Marine mammals • Sea turtles
Number of Lookouts and Observation Platform • 1 Lookout on the vessel that is underway
Mitigation Requirements • Mitigation zones: – 500 yd. around whales – 200 yd. around other marine mammals (except bow-riding dolphins and pinnipeds hauled out on man-made navigational structures, port structures, and vessels) – Within the vicinity of sea turtles • During the activity: – When underway, observe the mitigation zone for marine mammals and sea turtles; if observed, maneuver to maintain distance. – When underway in the turning basins, channels, and waterways adjacent to Naval Station Mayport, the Navy will comply with federal, state, and local Manatee Protection Zones and reduce speed in accordance with established operational safety and security procedures. – When mooring pierside at Kings Bay, Georgia, the Navy will ensure proper fendering techniques (e.g., the use of buoys that keep submarines 20 ft. off the quay wall) to prevent submarines from injuring a manatee. • Additional requirements: – The Navy will broadcast awareness notification messages with North Atlantic right whale Dynamic Management Area information (e.g., location and dates) to applicable Navy assets operating in the vicinity of the Dynamic Management Area. The information will alert assets to the possible presence of a North Atlantic right whale to maintain safety of navigation and further reduce the potential for a vessel strike. Platforms will use the information to assist their visual observation of applicable mitigation zones during training and testing activities and to aid in the implementation of procedural mitigation, including but not limited to mitigation for vessel movement. – The Navy will ensure that small boats operating out of Naval Station Mayport will be fitted with manatee propeller guards. Pursuant to the Naval Station Mayport Integrated Natural Resource Management Plan, the Navy will provide manatee awareness education to Harbor Operations personnel, require that manatee sightings are communicated to other vessels in the vicinity, and maintain signage at select locations that will alert personnel of the potential presence of manatees and the requirements and procedures for reporting manatee sightings. For information on protective measures pertaining to activities not conducted under the Proposed Action, see the Integrated Natural Resource Management Plan for Naval Station Mayport. – If a marine mammal or sea turtle vessel strike occurs, the Navy will follow the established incident reporting procedures.

As discussed in Section 5.3.1 (Environmental Awareness and Education), it is likely that the implementation of the Marine Species Awareness Training starting in 2007, and the additional U.S. Navy Afloat Environmental Compliance Training Series modules starting in 2014, has contributed to a reduction in marine mammal vessel strikes. The Navy is able to detect if a whale is struck due to the diligence of standard watch personnel and Lookouts stationed specifically to observe for marine mammals while a vessel is underway. In the unlikely event that a marine mammal vessel strike occurs, the Navy will notify the appropriate regulatory agency immediately or as soon as operational security considerations allow per the established incident reporting procedures described in Section 5.1.2.2.3 (Incident Reports). The Navy's incident reports include relevant information pertaining to the incident, including but not limited to vessel speed.

The small mitigation zone sizes and close proximity to the observation platform will result in a high likelihood that Lookouts will be able to detect marine mammals throughout the mitigation zones while vessels are underway. A mitigation zone size is not specified for sea turtles to allow flexibility based on vessel type and mission requirements (e.g., small boats operating in a narrow harbor). The mitigation measures for Naval Station Mayport and Kings Bay, Georgia will further help avoid impacts on manatees at these locations. The mitigation measures for submarine fendering techniques at Kings Bay, Georgia do not apply to other vessel types or locations (e.g., Naval Station Mayport) because of the unique method of mooring submarines to the Kings Bay wharf. Due to hull differences between submarines and the various surface ships, all vessels are not moored in the same manner. Submarine and surface ship berthing methods are primarily based on hull configuration and type of pier or quay wall within the port.

Dynamic Management Area information originates from NMFS. NMFS implements two types of vessel speed management areas off the U.S. East Coast, Seasonal Management Areas and Dynamic Management Areas, to reduce the likelihood of North Atlantic right whale vessel strikes. Under the regulations, the vessel speed restrictions are not mandatory for Federal agencies, such as the Navy. Seasonal Management Areas are located near ports, bay entrances, or areas where North Atlantic right whales could potentially occur. Seasonal Management Areas are in effect for up to 6 months every year, depending on the location. Unlike Seasonal Management Areas, which have static locations and time components based on potential animal occurrence, the locations and timing of Dynamic Management Areas fluctuate based on confirmed North Atlantic right whale detections. Dynamic Management Areas were in effect for approximately 3 months in 2018. Dynamic Management Areas cover extensive areas of water space that could overlap with essential Navy training and testing areas. Seasonal Management Areas overlap critical training and testing areas or are in proximity to Navy ports or pierside locations that are instrumental to training and testing in the Study Area (e.g., Naval Station Norfolk, Naval Station Mayport).

The Navy has developed the new mitigation measure to broadcast Dynamic Management Area information based on potential changes in North Atlantic right whale distribution. Platforms will use Dynamic Management Area information to assist their visual observation of applicable mitigation zones during training and testing activities. This will make units aware of North Atlantic right whale aggregations to better plan and conduct activities to minimize interactions with this species. Not only will this mitigation measure help the Navy further avoid or reduce potential impacts on North Atlantic right whales from vessel movements, it will also help aid the implementation of applicable procedural mitigation measures for acoustic, explosive, and physical disturbance and strike stressors when Dynamic Management Areas are in effect.

In addition to procedural mitigation, the Navy will continue to implement mitigation for vessel movements within select mitigation areas. For example, the Navy will implement vessel speed restrictions in certain locations seasonally in response to sightings of North Atlantic right whales, as described in Section 5.4.3 (Mitigation Areas off the Mid-Atlantic and Southeastern United States) and Section 5.4.2 (Mitigation Areas off the Northeastern United States). The Navy will implement a 10-knot speed restriction during certain portions of non-explosive torpedo activities in the Northeast North Atlantic Right Whale Mitigation Area. The Navy is able to implement a specific speed restriction for this activity due to the nature of how it is conducted. For example, during transits and normal firing, maintaining a speed of no more than 10 knots still allows the Navy to meet the activity’s intended objectives.

As described in Section 2.3.3.2 (Vessel Safety), Navy vessels are required to operate in accordance with applicable navigation rules, including Inland Navigation Rules (33 Code of Federal Regulations 83) and International Regulations for Preventing Collisions at Sea (72 COLREGS), which were formalized in the

Convention on the International Regulations for Preventing Collisions at Sea, 1972. These rules require that vessels proceed at a safe speed so proper and effective action can be taken to avoid collision and so vessels can be stopped within a distance appropriate to the prevailing circumstances and conditions. In addition to complying with navigation requirements, Navy ships transit at speeds that are optimal for fuel conservation, to maintain ship schedules, and to meet mission requirements. Vessel captains use the totality of the circumstances to ensure the vessel is traveling at appropriate speeds in accordance with navigation rules. Depending on the circumstances, this may involve adjusting speeds during periods of reduced visibility or in certain locations.

As discussed in Section 3.0.3.3.4.1 (Vessels and In-Water Devices), large Navy ships typically operate at average speeds of between 10 and 15 knots, which for reference is slower than large commercial vessels, such as container ships that steam at approximately 24 knots during normal operations (Maloni et al., 2013). Operating vessels at speeds that are not optimal for fuel conservation or mission requirements would be unsustainable due to increased time on station and increased fuel consumption. Each ship has a limited amount of time that it can be underway based on target service requirements and ship schedules. Ship schedules are driven largely by training cycles, scheduled maintenance periods, certification schedules, and deployment requirements. Because of the complex logistical considerations involved with maintaining ship schedules, the Navy does not have the flexibility to extend the amount of time that ships are underway, which would result from vessel speed restriction mitigation. If the Navy were to incorporate vessel speed restrictions into event planning for approximately 3–6 months out of the year, ships would be unable to meet all of their requirements during their limited time available to be underway. This would hold true even if the restrictions only applied to transits to and from training or testing event locations and not during the events themselves. Therefore, it would not be practical for the Navy to implement speed restrictions within Dynamic Management Areas or Seasonal Management Areas.

Navy vessel operators need to train to proficiently operate vessels as they would during military missions and combat operations, including being able to react to changing tactical situations and evaluate system capabilities. For example, during training activities involving flight operations from an aircraft carrier, the vessel must maintain a certain wind speed over the deck to launch or recover aircraft. Depending on wind conditions, the aircraft carrier itself must travel at a certain speed to generate the wind required to launch or recover aircraft. Implementing vessel speed restrictions would increase safety risks for Navy personnel and equipment and the public during the training event and would reduce skill proficiency in a way that would increase safety risks during military missions and combat operations. Furthermore, vessel speed restrictions would not allow the Navy to continue meeting its training requirements due to diminished realism of training exercises.

The Navy needs to test the full range of its vessel and system capabilities to ensure safety and functionality in conditions analogous to military missions and combat operations. For example, during non-explosive torpedo testing activities, the Navy must operate its vessels using speeds typical of military missions and combat operations to accurately test the functionality of its acoustic countermeasures and torpedo systems during firing on submarine and vessel targets. The Navy conducts some activities, such as Aircraft Carrier Sea Trials – Propulsion Testing, specifically to test the functionality of vessel propulsion systems, including maneuvering, full-power runs, and endurance runs. During this event, ships must operate across the full spectrum of capable speeds to accomplish the primary testing objectives. Vessel speed restrictions would not allow the Navy to continue meeting its testing program requirements due to diminished realism of testing events. Researchers, program managers, and weapons system acquisition programs would be unable to conduct accurate acoustic research to meet research objectives and effectively test vessels and vessel-deployed systems and platforms before full-scale production or delivery to the fleet. Such testing is required to ensure functionality and accuracy in military mission and combat conditions per required acquisition milestones or on an as-needed basis to meet operational requirements.

In summary, the operational community determined that implementing procedural mitigation for vessel movements beyond what is detailed in Table 5.3-18 and implementing restrictions on vessel speed beyond what is detailed in Table 5.4-2 and Table 5.4-3 (including speed restrictions in Dynamic Management Areas, Seasonal Management Areas, or other locations in the Study Area) would be incompatible with the practicality assessment criteria for safety, sustainability, and mission requirements.

5.3.4.2 Towed In-Water Devices

The Navy will continue to implement procedural mitigation to avoid or reduce the potential for strike of marine mammals and sea turtles from towed in-water devices, as outlined in Table 5.3-19. Vessels involved in towing in-water devices will implement the mitigation described in Section 5.3.4.1 (Vessel Movement), in addition to the mitigation outlined in Table 5.3-19.

Table 5.3-19: Procedural Mitigation for Towed In-Water Devices

Procedural Mitigation Description
Stressor or Activity • Towed in-water devices – Mitigation applies to devices that are towed from a manned surface platform or manned aircraft – The mitigation will not be applied if the safety of the towing platform or in-water device is threatened
Resource Protection Focus • Marine mammals • Sea turtles
Number of Lookouts and Observation Platform • 1 Lookout positioned on the manned towing platform
Mitigation Requirements • Mitigation zones: – 250 yd. around marine mammals – Within the vicinity of sea turtles • During the activity (i.e., when towing an in-water device): – Observe the mitigation zone for marine mammals and sea turtles; if observed, maneuver to maintain distance.

The small mitigation zone size and proximity to the observation platform will result in a high likelihood that Lookouts will be able to detect marine mammals throughout the mitigation zone when manned vessels or manned aircraft are towing in-water devices. A mitigation zone size is not specified for sea turtles to allow flexibility based on towing platform type and mission requirements (e.g., small boats operating in a narrow harbor).

The mitigation zones for towed in-water devices are based on the largest areas within which it is practical for the Navy to implement mitigation. When developing Phase III mitigation, the Navy analyzed the potential for increasing the size of the mitigation zones. Mission and safety requirements determine the operational parameters (e.g., course) for in-water device towing platforms. Towed in-water devices must be towed at certain speeds and water depths for stability, which are controlled in part by the towing platform's speed and directional movements. Because these devices are towed and not self-propelled, they generally have limited maneuverability and are not able to make immediate course corrections. For example, during a Mine Countermeasure – Towed Mine Neutralization activity using rotary-wing aircraft, towed devices are used to trigger mines and perform various other functions, such as detaching floating moored mines. A high degree of pilot skill is required in deploying devices, safely towing them at relatively low speeds and altitudes, and then recovering devices. The aircraft can safely alter course to shift the route of the towed device in response to a sighted marine mammal or sea turtle up to a certain extent (i.e., up to the size of the mitigation zone) while still maintaining the parameters needed for stable towing. However, the aircraft would be unable to further alter its course to more drastically course-correct the towed device without decreasing towing stability, which would have implications for safety of personnel and equipment.

5.3.4.3 Small-, Medium-, and Large-Caliber Non-Explosive Practice Munitions

The Navy will continue to implement procedural mitigation to avoid or reduce the potential for strike of marine mammals and sea turtles from small-, medium-, and large-caliber non-explosive practice munitions, as outlined in Table 5.3-20. In addition to procedural mitigation, the Navy will implement mitigation for small-, medium-, and large-caliber non-explosive practice munitions within mitigation areas (see Section 5.4.1, Mitigation Areas for Seafloor Resources and Section 5.4.3, Mitigation Areas off the Mid-Atlantic and Southeastern United States).

Table 5.3-20: Procedural Mitigation for Small-, Medium-, and Large-Caliber Non-Explosive Practice Munitions

Procedural Mitigation Description
<u>Stressor or Activity</u> • Gunnery activities using small-, medium-, and large-caliber non-explosive practice munitions   – Mitigation applies to activities using a surface target
<u>Resource Protection Focus</u> • Marine mammals • Sea turtles
<u>Number of Lookouts and Observation Platform</u> • 1 Lookout positioned on the platform conducting the activity   – Depending on the activity, the Lookout could be the same as the one described in Section 5.3.2.4 (Weapons Firing Noise).

<u>Mitigation Requirements</u>
• Mitigation zone:
  – 200 yd. around the intended impact location
• Prior to the initial start of the activity (e.g., when maneuvering on station):
  – Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear.
  – Observe the mitigation zone for marine mammals and sea turtles; if observed, relocate or delay the start of firing.
• During the activity:
  – Observe the mitigation zone for marine mammals and sea turtles; if observed, cease firing.
• Commencement/recommencement conditions after a marine mammal or sea turtle sighting before or during the activity:
  – The Navy will allow a sighted marine mammal or sea turtle to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following conditions has been met: (1) the animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; (3) the mitigation zone has been clear from any additional sightings for 10 min. for aircraft-based firing or 30 min. for vessel-based firing; or (4) for activities using a mobile target, the intended impact location has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

The mitigation zone is conservatively designed to be several times larger than the impact footprint for large-caliber non-explosive practice munitions, which are the largest projectiles based on the military expended material impact footprints calculated in Appendix F (Military Expended Material and Direct Strike Impact Analysis). Small-caliber and medium-caliber non-explosive practice munitions have smaller impact footprints than large-caliber non-explosive practice munitions; therefore, the mitigation zone will extend even further beyond the impact footprints for these smaller projectiles.

Large-caliber gunnery activities involve vessels firing projectiles at a target located up to 6 NM down range. Small- and medium-caliber gunnery activities involve vessels or aircraft firing projectiles at targets located up to 4,000 yd. down range, although typically much closer. Lookouts will have a better likelihood of detecting marine mammals and sea turtles when observing mitigation zones around targets located close to the firing platform. When observing activities that use a target located far from the firing platform, Lookouts will be more likely to detect large visual cues (e.g., whale blows or large pods of dolphins) than individual marine mammals, cryptic marine mammal species, and sea turtles. Observing for indicators of marine mammal and sea turtle presence will further help avoid or reduce potential impacts on these resources within the mitigation zone. Positioning additional observers closer to the targets would increase safety risks because these platforms would be located in the vicinity of an intended impact location or in the path of a projectile.

5.3.4.4 Non-Explosive Missiles and Rockets

The Navy will continue to implement procedural mitigation to avoid or reduce the potential for strike of marine mammals and sea turtles from non-explosive missiles and rockets, as outlined in Table 5.3-21. In addition to procedural mitigation, the Navy will implement mitigation for non-explosive missiles and rockets within mitigation areas (see Section 5.4.1, Mitigation Areas for Seafloor Resources and Section 5.4.3, Mitigation Areas off the Mid-Atlantic and Southeastern United States).

Table 5.3-21: Procedural Mitigation for Non-Explosive Missiles and Rockets

Procedural Mitigation Description
Stressor or Activity • Aircraft-deployed non-explosive missiles and rockets   – Mitigation applies to activities using a surface target
Resource Protection Focus • Marine mammals • Sea turtles
Number of Lookouts and Observation Platform • 1 Lookout positioned in an aircraft

Mitigation Requirements
• Mitigation zone:
   – 900 yd. around the intended impact location
• Prior to the initial start of the activity (e.g., during a fly-over of the mitigation zone):
   – Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear.
   – Observe the mitigation zone for marine mammals and sea turtles; if observed, relocate or delay the start of firing.
• During the activity:
   – Observe the mitigation zone for marine mammals and sea turtles; if observed, cease firing.
• Commencement/recommencement conditions after a marine mammal or sea turtle sighting prior to or during the activity:
   – The Navy will allow a sighted marine mammal or sea turtle to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing firing) until one of the following conditions has been met: (1) the animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended impact location; or (3) the mitigation zone has been clear from any additional sightings for 10 min. when the activity involves aircraft that have fuel constraints, or 30 min. when the activity involves aircraft that are not typically fuel constrained.

The mitigation zone for non-explosive missiles and rockets is conservatively designed to be several times larger than the impact footprint for the largest non-explosive missile based on the military expended material impact footprints calculated in Appendix F (Military Expended Material and Direct Strike Impact Analysis). Smaller non-explosive missiles and non-explosive rockets have smaller impact footprints than the largest non-explosive missile used for these activities; therefore, the mitigation zone will extend even further beyond the impact footprints for these smaller projectiles.

Mitigation applies to activities using non-explosive missiles or rockets fired from aircraft at targets that are typically located up to 15 NM down range, and infrequently up to 75 NM down range. There is a chance that animals could enter the mitigation zone after the aircraft conducts its close-range mitigation zone observations and before firing begins (once the aircraft has transited to its firing position). Due to the distance between the mitigation zone and the observation platform, Lookouts will have a better likelihood of detecting marine mammals and sea turtles during the close-range observations and are less likely to detect these resources once positioned at the firing location, particularly individual marine mammals, cryptic marine mammal species, and sea turtles. Observing for indicators of marine mammal and sea turtle presence will further help avoid or reduce potential impacts on these resources within the mitigation zone during the close-range observations. The mitigation only applies to aircraft-deployed missiles and rockets for the reasons discussed in Section 5.3.3.4 (Explosive Missiles and Rockets). Positioning additional observers closer to the targets would increase safety risks because these platforms would be located in the vicinity of an intended impact location or in the path of a projectile.

5.3.4.5 Non-Explosive Bombs and Mine Shapes

The Navy will continue to implement procedural mitigation to avoid or reduce the potential for strike of marine mammals and sea turtles from non-explosive bombs and mine shapes, as outlined in Table 5.3-22. In addition to procedural mitigation, the Navy will implement mitigation for non-explosive bombs and mine shapes within mitigation areas (see Section 5.4.1, Mitigation Areas for Seafloor Resources; Section 5.4.2, Mitigation Areas off the Northeastern United States; and Section 5.4.3, Mitigation Areas off the Mid-Atlantic and Southeastern United States).

Table 5.3-22: Procedural Mitigation for Non-Explosive Bombs and Mine Shapes

Procedural Mitigation Description
Stressor or Activity • Non-explosive bombs • Non-explosive mine shapes during mine laying activities
Resource Protection Focus • Marine mammals • Sea turtles
Number of Lookouts and Observation Platform • 1 Lookout positioned in an aircraft
Mitigation Requirements • Mitigation zone: − 1,000 yd. around the intended target • Prior to the start of the activity (e.g., when arriving on station): − Observe the mitigation zone for floating vegetation; if observed, relocate or delay the start until the mitigation zone is clear. − Observe the mitigation zone for marine mammals and sea turtles; if observed, relocate or delay the start of bomb deployment or mine laying. • During the activity (e.g., during approach of the target or intended minefield location): − Observe the mitigation zone for marine mammals and sea turtles; if observed, cease bomb deployment or mine laying. • Commencement/recommencement conditions after a marine mammal or sea turtle sighting prior to or during the activity: − The Navy will allow a sighted marine mammal or sea turtle to leave the mitigation zone prior to the initial start of the activity (by delaying the start) or during the activity (by not recommencing bomb deployment or mine laying) until one of the following conditions has been met: (1) the animal is observed exiting the mitigation zone; (2) the animal is thought to have exited the mitigation zone based on a determination of its course, speed, and movement relative to the intended target or minefield location; (3) the mitigation zone has been clear from any additional sightings for 10 min.; or (4) for activities using mobile targets, the intended target has transited a distance equal to double that of the mitigation zone size beyond the location of the last sighting.

The mitigation zone for non-explosive bombs and mine shapes is conservatively designed to be several times larger than the impact footprint for the largest non-explosive bomb based on the military expended material impact footprints calculated in Appendix F (Military Expended Material and Direct Strike Impact Analysis). Smaller non-explosive bombs and mine shapes have smaller impact footprints than the largest non-explosive bomb used for these activities; therefore, the mitigation zone will extend even further beyond the impact footprints for these smaller military expended materials.

Activities involving non-explosive bombing and mine laying involve aircraft deploying munitions or mine shapes from a relatively steady altitude of approximately 1,500 ft. at a surface target or in an intended minefield located beneath the aircraft. Due to the mitigation zone size, proximity to the observation platform, and the good vantage point from an aircraft, Lookouts will be able to observe the entire mitigation zone during approach of the target or intended minefield location. Observing for indicators of marine mammal and sea turtle presence will further help avoid or reduce potential impacts on these resources within the mitigation zone.

5.4 Mitigation Areas to be Implemented

The first section (Section 5.4.1, Mitigation Areas for Seafloor Resources) describes mitigation areas that are designed to avoid or reduce potential impacts on seafloor resources throughout the Study Area. The remaining sections are organized by geographic region.

5.4.1 Mitigation Areas for Seafloor Resources

As outlined in Table 5.4-1 and shown in Figure 5.4-1, Figure 5.4-2, and Figure 5.4-3, the Navy will implement mitigation to avoid or reduce potential impacts on biological or cultural resources that are not observable by Lookouts from the water's surface (i.e., resources for which procedural mitigation cannot be implemented).

5.4.1.1 Resource Description

Seafloor resources fulfill important ecosystem functions. Live hard bottom habitats and artificial structures (e.g., artificial reefs, shipwrecks) provide attachment substrate for aquatic vegetation and invertebrates, such as corals, seaweed, seagrass, macroalgae, and sponges. These habitats in turn support a community of organisms, such as fish, shrimp, crabs, barnacles, worms, and sea cucumbers. Shallow-water coral reefs provide substrate, shelter, and food for hundreds of invertebrate species, sea turtles, fishes, and other biological resources. They are one of the most productive and diverse assemblages on Earth.

Dive sites occur throughout nearshore areas of the Study Area where there are shipwrecks, artificial reefs, and shallow-water coral reefs, making these resources highly valuable from a socioeconomic standpoint. Similarly, submerged aquatic vegetation provides important habitat for commercially and recreationally important fish species. Historic shipwrecks are classified as archaeological resources and are an important part of maritime history. For additional information on the biological, cultural, and socioeconomic importance of seafloor resources and their associated ecosystem components, refer to Chapter 3.3 (Vegetation), Chapter 3.4 (Invertebrates), Chapter 3.5 (Habitats), Chapter 3.6 (Fishes), Chapter 3.7 (Marine Mammals), Chapter 3.8 (Reptiles), Chapter 3.10 (Cultural Resources), and Chapter 3.11 (Socioeconomics).

Table 5.4-1: Mitigation Areas for Seafloor Resources

Mitigation Area Description
Stressor or Activity • Explosives • Physical disturbance and strikes
Resource Protection Focus • Shallow-water coral reefs • Live hard bottom • Artificial reefs • Submerged aquatic vegetation • Shipwrecks
Mitigation Area Requirements (year-round) • **Within the anchor swing circle of shallow-water coral reefs, live hard bottom, artificial reefs, submerged aquatic vegetation, and shipwrecks:** – The Navy will not conduct precision anchoring (except in designated anchorages). • **Within a 350-yd. radius of live hard bottom, artificial reefs, submerged aquatic vegetation, and shipwrecks:** – The Navy will not conduct explosive mine countermeasure and neutralization activities or explosive mine neutralization activities involving Navy divers (except in designated locations, such as Truman Harbor and Demolition Key, where these resources will be avoided to the maximum extent practicable). – The Navy will not place mine shapes, anchors, or mooring devices on the seafloor. • **Within a 350-yd. radius of shallow-water coral reefs:** – The Navy will not conduct explosive or non-explosive small-, medium-, and large-caliber gunnery activities using a surface target; explosive or non-explosive missile and rocket activities using a surface target; explosive or non-explosive bombing and mine laying activities; explosive or non-explosive mine countermeasure and neutralization activities; and explosive or non-explosive mine neutralization activities involving Navy divers. – The Navy will not place mine shapes, anchors, or mooring devices on the seafloor. • **Within the Key West Range Complex:** – Vessels will operate within waters deep enough to avoid bottom scouring or prop dredging, with at least a 1-ft. clearance between the deepest draft of the vessel (with the motor down) and the seafloor at mean low water. • **Within the South Florida Ocean Measurement Facility Testing Range:** – The Navy will use real-time geographic information system and global positioning system (along with remote sensing verification) during deployment, installation, and recovery of anchors and mine-like objects and during deployment of bottom-crawling unmanned underwater vehicles in waters deeper than 10 ft. to avoid shallow-water coral reefs and live hard bottom. – Vessels deploying anchors, mine-like objects, and bottom-crawling unmanned underwater vehicles will aim to hold a relatively fixed position over the intended mooring or deployment location using a dynamic positioning navigation system with global positioning system. – The Navy will minimize vessel movement and drift in accordance with mooring installation and deployment plans and will conduct activities during sea and wind conditions that allow vessels to maintain position and speed control during deployment, installation, and recovery of anchors, mine-like objects, and bottom-crawling unmanned underwater vehicles. – Vessels will operate within waters deep enough to avoid bottom scouring or prop dredging, with at least a 1-ft. clearance between the deepest draft of the vessel (with the motor down) and the seafloor at mean low water. – The Navy will not anchor vessels or spud over shallow-water coral reefs and live hard bottom. – The Navy will use semi-permanent anchoring systems that are assisted with riser buoys over soft bottom habitats to avoid contact of mooring cables with shallow-water coral reefs and live hard bottom.

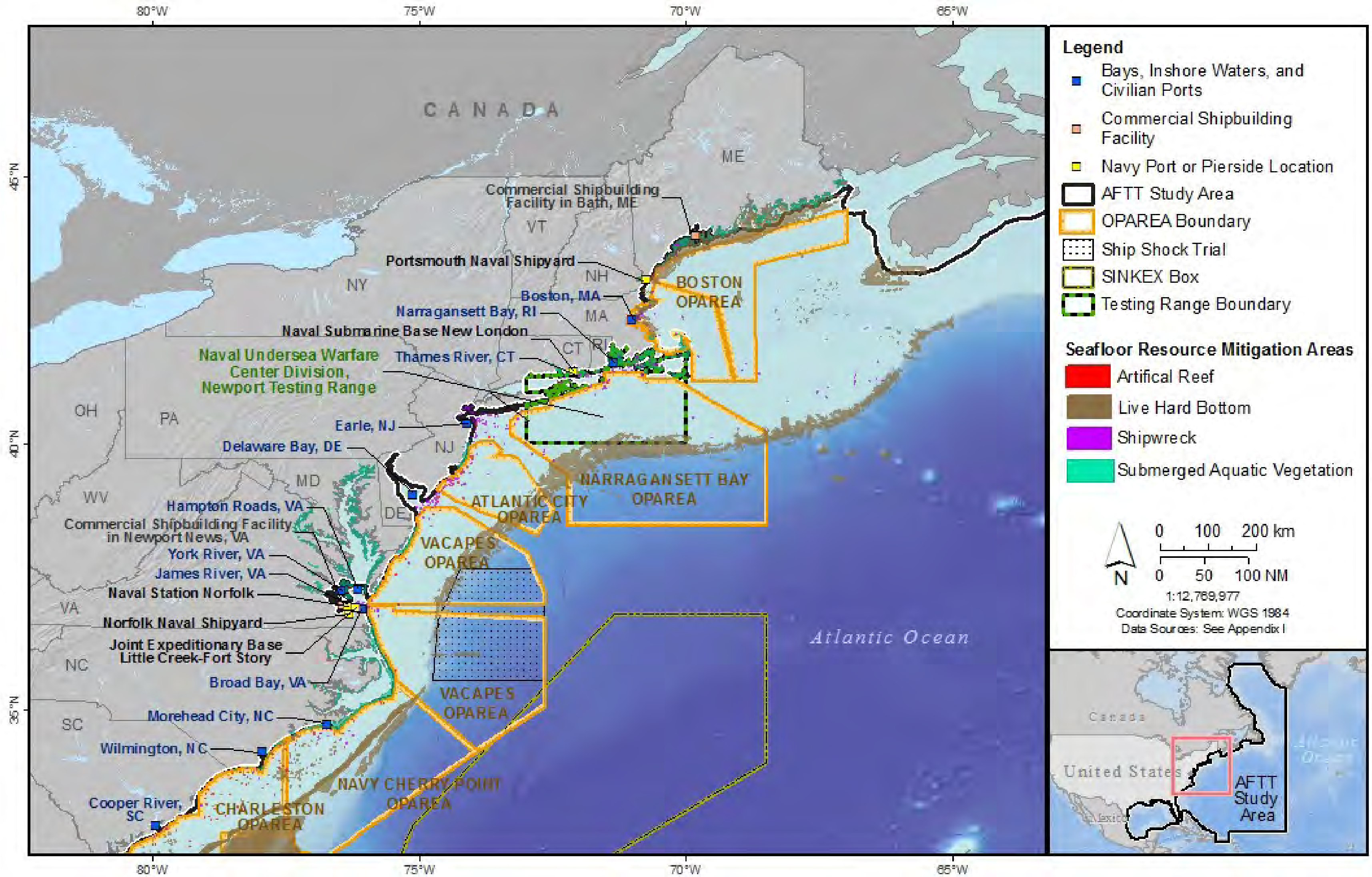
5.4.1.2 Mitigation Area Assessment

Without mitigation, explosives and physical disturbance and strike stressors could potentially impact shallow-water coral reefs, live hard bottom, artificial reefs, submerged aquatic vegetation, shipwrecks, and their associated ecosystem components during certain training and testing activities in the Study Area. The Navy developed mitigation areas as either the anchor swing circle diameter or a 350-yd. radius around a seafloor resource, as indicated by the best available georeferenced data. Mitigating within the anchor swing circle will protect seafloor resources during precision anchoring activities when factoring in environmental conditions that could affect anchoring position and swing circle size, such as winds, currents, and water depth. For other activities applicable to the mitigation, a 350-yd. radius around a seafloor resource is a conservatively sized mitigation area that will provide protection well beyond the maximum expected impact footprint (e.g., crater and expelled material radius) of the explosives and non-explosive practice munitions used in the Study Area. As described in Appendix F (Military Expended Material and Direct Strike Impact Analysis), the military expended material with the largest footprint that applies to the mitigation is an explosive mine with 650-lb. net explosive weight, which has an estimated impact footprint of approximately 14,800 square ft. and associated radius of 22.7 yd. The 350-yd. mitigation zone is well beyond the maximum expected direct impact footprint for the activities listed in Table 5.4-1, and further mitigates some level of indirect impact from explosive disturbances. Other applicable explosive activities and non-explosive practice munitions have a smaller impact footprint; therefore, the mitigation area will result in additional protection during those activities.

The seafloor resource mitigation areas will help the Navy avoid or reduce potential impacts from explosives and physical disturbance and strike stressors on sensitive seafloor resources and to any biological or cultural resources that inhabit, shelter, rest, feed, or occur in the mitigation areas. As described in Chapter 3.5 (Habitats), other habitats, such as soft bottom, are expected to recover relatively quickly from potential disturbances; therefore, there would be a limited benefit of mitigation for other habitat types. The Navy does not have mitigation specific to scallop beds or deep-sea coral reefs because training and testing activities do not use bottom-placed explosive charges in locations where these resources are known to occur, such as within the Northeast Range Complexes.

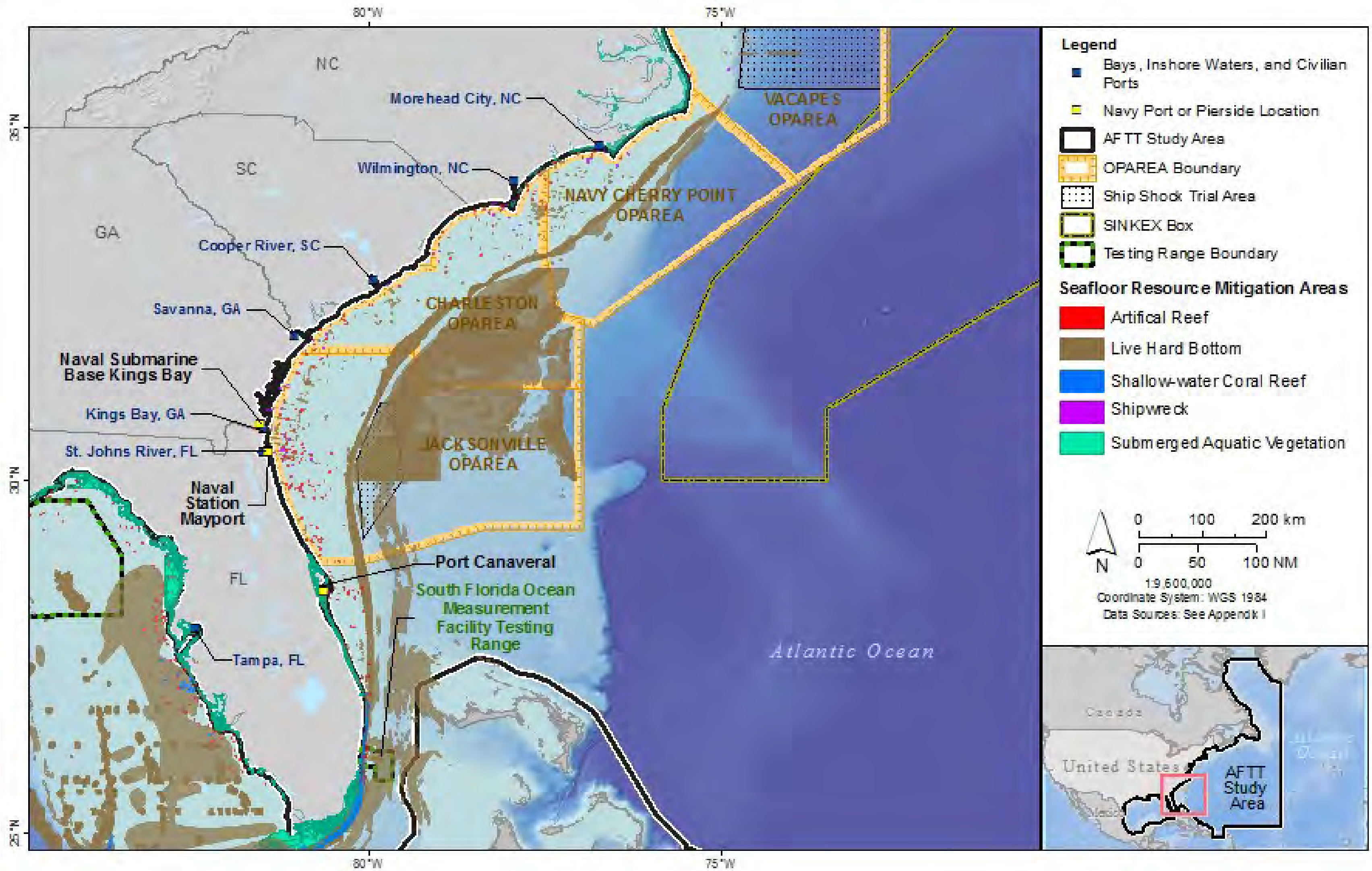
To facilitate mitigation implementation, the Navy will include maps of the best available georeferenced data for shallow-water coral reefs, artificial reefs, live hard bottom, submerged aquatic vegetation, and shipwrecks in its Protective Measures Assessment Protocol. The Navy will include data that most accurately represent the natural boundaries of seafloor resources, as described in *Building and Maintaining a Comprehensive Database and Prioritization Scheme for Overlapping Habitat Data* (U.S. Department of the Navy, 2018b). Data presented in Chapter 3.3 (Vegetation), Chapter 3.4 (Invertebrates), Chapter 3.5 (Habitats), and Chapter 3.10 (Cultural Resources) will serve as the baseline of best available georeferenced data for seafloor resource mitigation areas. Mitigation areas apply to georeferenced resources because the Navy requires accurate resource identification and mapping for mitigation to be effective and practical to implement.

Input from the operational community indicates that the mitigation detailed in Table 5.4-1 is practical to implement. Implementing additional mitigation for other activities or types of seafloor resources would not allow the Navy to continue meeting its mission requirements to successfully accomplish military readiness objectives. Expanding the mitigation to protect additional seafloor features where marine species are known to occur (e.g., soft bottom, which provides habitat for resources such as worms and clams) would essentially result in the Navy not conducting training and testing activities along the entire U.S. Atlantic Coast and in the Gulf of Mexico. This would prohibit the Navy from accessing a majority of its ranges and operating areas and conducting the Proposed Action in environments that are analogous to where the military operates, or may need to operate in the future, which would prevent it from meeting its mission requirements. This would also push training and testing activities farther offshore, which would have implications for safety and sustainability. Moving activities farther offshore would increase the distance from aircraft emergency landing fields, critical medical facilities, and search and rescue capabilities; would require excessive time on station or time away from homeport for Navy personnel; and would result in significant increases to operational costs.



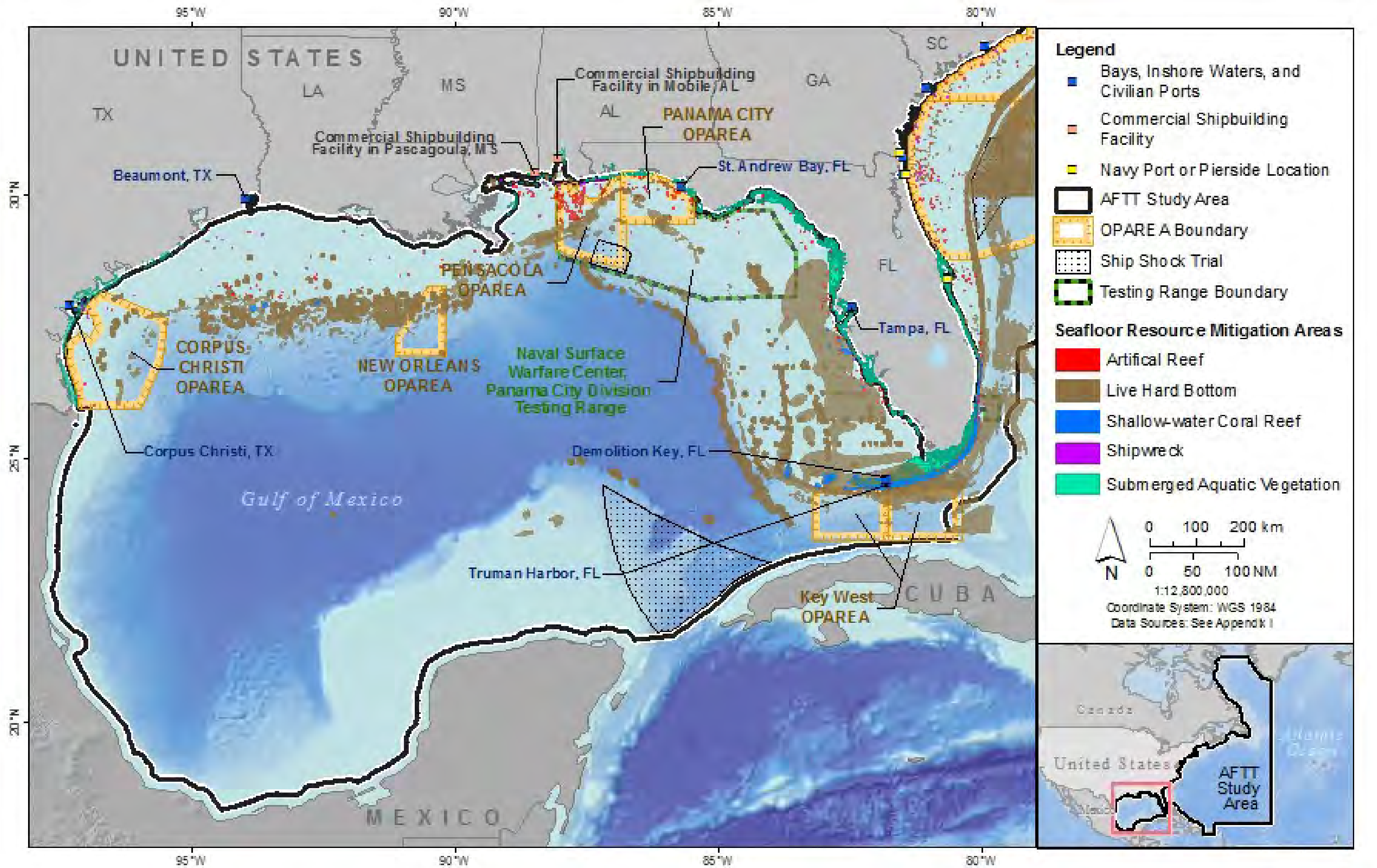
Notes: AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area; SINKEX: sinking exercise; VACAPES: Virginia Capes

Figure 5.4-1: Seafloor Resource Mitigation Areas off the Northeastern United States



Notes: AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area; SINKEX: sinking exercise; VACAPES: Virginia Capes

Figure 5.4-2: Seafloor Resource Mitigation Areas off the Mid-Atlantic and Southeastern United States



Notes: AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area

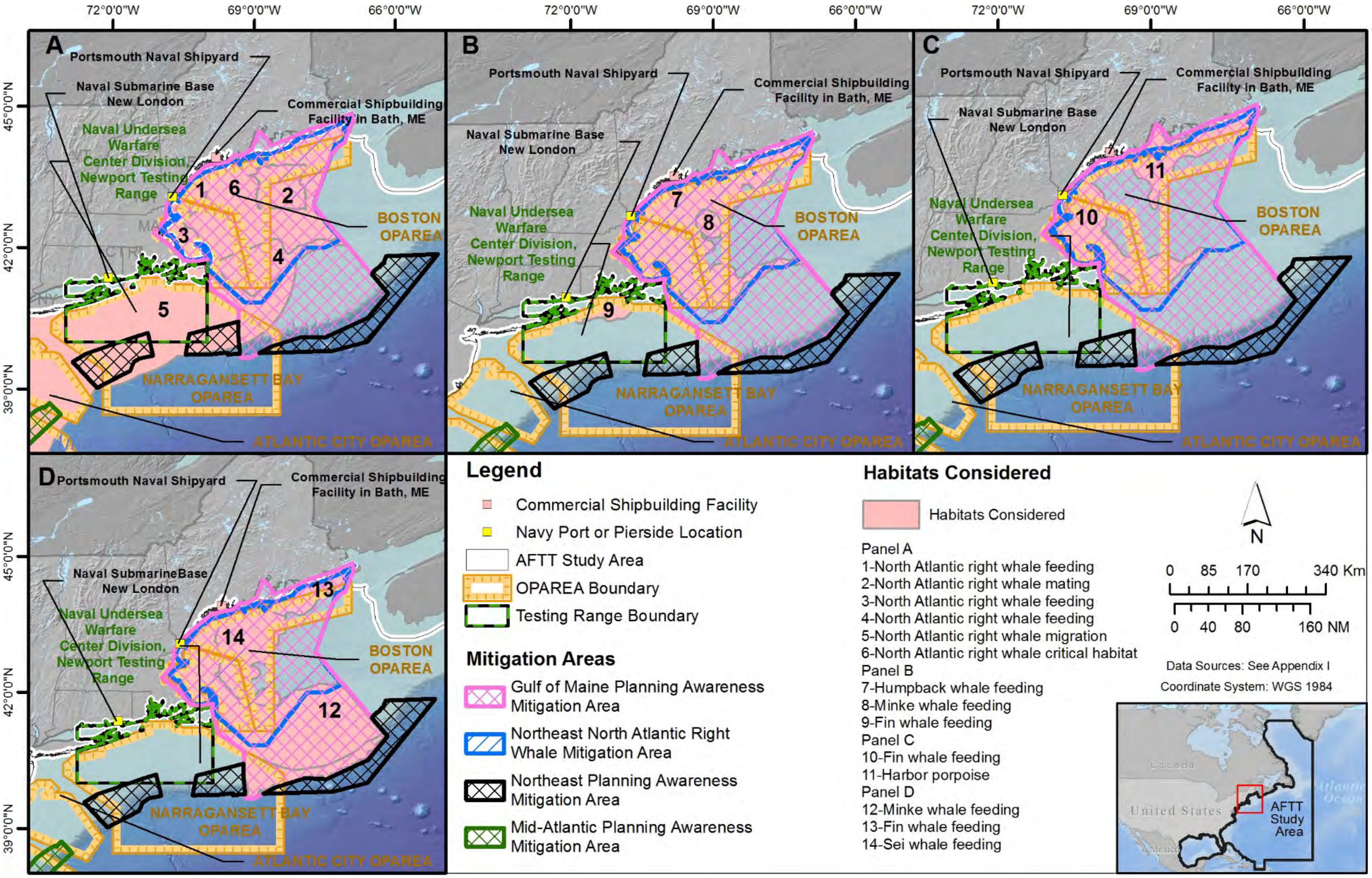
Figure 5.4-3: Seafloor Resource Mitigation Areas in the Gulf of Mexico

5.4.2 Mitigation Areas off the Northeastern United States

As described in Table 5.4-2 and shown in Figure 5.4-4, the Navy will implement mitigation within mitigation areas off the northeastern United States to, in combination with procedural mitigation, effect the least practicable adverse impact on marine mammal species or stocks and their habitat.

Table 5.4-2: Mitigation Areas off the Northeastern United States

Mitigation Area Description
Stressor or Activity • Sonar • Explosives • Physical disturbance and strikes
Resource Protection Focus • Marine mammals
Mitigation Area Requirements (year-round) • **Northeast North Atlantic Right Whale Mitigation Area:** – The Navy will report the total hours and counts of active sonar and in-water explosives used in the mitigation area (i.e., the northeast North Atlantic right whale critical habitat) in its annual training and testing activity reports submitted to NMFS. – The Navy will minimize the use of low-frequency active sonar, mid-frequency active sonar, and high-frequency active sonar to the maximum extent practicable within the mitigation area. – The Navy will not use Improved Extended Echo Ranging sonobuoys (within 3 NM of the mitigation area), explosive and non-explosive bombs, in-water detonations, and explosive torpedoes within the mitigation area. – For activities using non-explosive torpedoes within the mitigation area, the Navy will conduct activities during daylight hours in Beaufort sea state 3 or less. The Navy will use three Lookouts (one positioned on a vessel and two in an aircraft during dedicated aerial surveys) to observe the vicinity of the activity. An additional Lookout will be positioned on the submarine, when surfaced. Immediately prior to the start of the activity, Lookouts will observe for floating vegetation and marine mammals; if observed, the activity will not commence until the vicinity is clear or the activity is relocated to an area where the vicinity is clear. During the activity, Lookouts will observe for marine mammals; if observed, the activity will cease. To allow a sighted marine mammal to leave the area, the Navy will not recommence the activity until one of the following conditions has been met: (1) the animal is observed exiting the vicinity of the activity; (2) the animal is thought to have exited the vicinity of the activity based on a determination of its course, speed, and movement relative to the activity location; or (3) the area has been clear from any additional sightings for 30 min. During transits and normal firing, ships will maintain a speed of no more than 10 knots. During submarine target firing, ships will maintain speeds of no more than 18 knots. During vessel target firing, vessel speeds may exceed 18 knots for brief periods of time (e.g., 10–15 min.). – Before vessel transits within the mitigation area, the Navy will conduct a web query or email inquiry to the National Oceanographic and Atmospheric Administration Northeast Fisheries Science Center's North Atlantic Right Whale Sighting Advisory System to obtain the latest North Atlantic right whale sightings information. Vessels will use the sightings information to reduce potential interactions with North Atlantic right whales during transits. Vessels will implement speed reductions within the mitigation area after observing a North Atlantic right whale, if transiting within 5 NM of a sighting reported to the North Atlantic Right Whale Sighting Advisory System within the past week, and if transiting at night or during periods of reduced visibility. • **Gulf of Maine Planning Awareness Mitigation Area:** – The Navy will report the total hours and counts of active sonar and in-water explosives used in the mitigation area in its annual training and testing activity reports submitted to NMFS. – The Navy will not conduct >200 hours of hull-mounted mid-frequency active sonar per year within the mitigation area. – The Navy will not conduct major training exercises (Composite Training Unit Exercises or Fleet Exercises/Sustainment Exercises) within the mitigation area. If the Navy needs to conduct a major training exercise within the mitigation area in support of training requirements driven by national security concerns, it will confer with NMFS to verify that potential impacts are adequately addressed in this Final EIS/OEIS and associated consultation documents. • **Northeast Planning Awareness Mitigation Areas:** – The Navy will avoid conducting major training exercises (Composite Training Unit Exercises or Fleet Exercises/Sustainment Exercises) within the mitigation area to the maximum extent practicable. – The Navy will not conduct more than four major training exercises per year within the mitigation area (all or a portion of the exercise). If the Navy needs to conduct additional major training exercises in the mitigation area in support of training requirements driven by national security concerns, it will provide NMFS with advance notification and include the information in its annual training and testing activity reports submitted to NMFS.



Notes: AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area

Figure 5.4-4: Mitigation Areas and Habitats Considered off the Northeastern United States

5.4.2.1 Resource Description

The Navy assessed the northeastern United States region for potential mitigation areas. The assessment included, but was not limited to, the following marine mammal areas that have been established by NMFS as critical habitat or identified by LaBrecque et al. (2015b) as biologically important areas (as shown in Figure 5.4-4 and described in the sections below):

- Fin whale feeding area in the northern Gulf of Maine (June through October)
- Fin whale feeding area in the southern Gulf of Maine (year-round)
- Fin whale feeding area east of Montauk Point (March through October)
- Harbor porpoise small and resident population in the Gulf of Maine (July through September)
- Humpback whale feeding area in the Gulf of Maine, Stellwagen Bank, and the Great South Channel (March through December)
- Minke whale feeding area in the central Gulf of Maine - Parker Ridge and Cashes Ledge (March through November)
- Minke whale feeding area in the southwestern Gulf of Maine and Georges Bank (March through November)
- North Atlantic right whale critical habitat (northeastern U.S. foraging area; year-round)
- North Atlantic right whale mating area in the central Gulf of Maine (November through January)
- North Atlantic right whale feeding area on Jeffreys Ledge (June through July, October through December)
- North Atlantic right whale feeding area on Cape Cod Bay and Massachusetts Bay (February through April)
- North Atlantic right whale feeding area in the Great South Channel and on the northern edge of Georges Bank (April through June)
- North Atlantic right whale migratory corridor along the U.S. East Coast (upper portion) (November through December, March through April)
- Sei whale feeding area in the Gulf of Maine (May through November)

5.4.2.1.1 Fin Whales

Three areas in the AFTT Study Area were identified as biologically important fin whale feeding areas by LaBrecque et al. (2015b): (1) June to October in the northern Gulf of Maine; (2) year-round in the southern Gulf of Maine; and (3) March to October east of Montauk Point, which is located off the eastern tip of Long Island, New York. These areas were substantiated through vessel-based survey data, photo-identification data, and expert judgment.

New England waters are considered the primary feeding grounds for fin whales (Waring et al., 2016). Fin whales are often seen closer to shore after periodic patterns of upwelling (upward water motion) and the resultant increased prey density (Azzellino et al., 2008). This species is highly adaptable, often following its prey off the continental shelf (Azzellino et al., 2008; Panigada et al., 2008). Fin whales feed primarily in higher latitudes from March through October when primary prey availability is high (Mizroch et al., 1984a), but more recently have been found to also feed in more southerly latitudes (Silva et al., 2013). An important fin whale feeding area is located south of New England and directly east of Montauk Point between the 15-meter (m) and 50-m contours (Hain et al., 1992). Though most of the published literature on fin whale feeding areas is based on data more than 10 years old, LaBrecque et al.

(2015b) noted that unpublished sighting data of feeding fin whales from the Provincetown Center for Coastal Studies (1984–2011) spatially coincide with previously published data, indicating that these feeding areas continue to be important to the species. Data from Waring et al. (2016) and Palka (2012) also show that fin whales continue to use these areas at least seasonally.

Fin whale sightings and acoustic detections are highest in New England waters during spring and summer (Hain et al., 1992; Morano et al., 2012b; Waring et al., 2014). Agler et al. (1993) reported that fin whales were seen in the southern Gulf of Maine from March to October, while fin whales in the northern Gulf of Maine were seen only from June to October. In the southwestern Gulf of Maine, Provincetown Center for Coastal Studies recorded sightings of feeding fin whales in all months of the year; therefore, feeding in the southern Gulf of Maine is considered to occur year-round (LaBrecque et al., 2015b).

Multi-year photo-identification data from the Gulf of Maine and Massachusetts Bay shows that individual fin whales displayed site fidelity over successive years. There is evidence of site fidelity by females and potentially some segregation by sexual, maturational, or reproductive class in the feeding areas (Agler et al., 1993; Waring et al., 2016). Photo-identification records from 1974–1988 show that female fin whales exhibit feeding site fidelity in the lower Bay of Fundy, Seal Island, and Mt. Desert in the northern Gulf of Maine and in the Great South Channel, Jeffreys Ledge, and Stellwagen Bank in the southern Gulf of Maine (Agler et al., 1993). Photo-identification records from 1980–1987 identified 156 individual fin whales within the Massachusetts Bay area feeding grounds (Seipt et al., 1990). Approximately 62 percent of these individuals were observed more than once and 45 percent were photographed in multiple years (some as many as 8 years) (Seipt et al., 1990).

For additional information about fin whale habitats and geographic range, see Section 3.7.2.2.4.2 (Habitat and Geographic Range).

5.4.2.1.2 Harbor Porpoise

One area in the AFTT Study Area was identified as a biologically important area for a small and resident population of harbor porpoises in the Gulf of Maine from July through September (LaBrecque et al., 2015b). The area was delineated based on NMFS vessel and aerial surveys, genetic analyses, strandings, and bycatch reports, which have identified the area as having high concentrations of harbor porpoises seasonally (LaBrecque et al., 2015b).

In the U.S. Atlantic Ocean, harbor porpoises occur from the Bay of Fundy to North Carolina. From July to September, harbor porpoises are generally concentrated in the northern Gulf of Maine and southern Bay of Fundy region in waters shallower than 150 m (Gaskin, 1977; Kraus et al., 1983; Palka, 1995a; Palka, 1995b), with a few sightings in the upper Bay of Fundy and on the northern edge of Georges Bank (Palka, 2000). From October to December and April to June, harbor porpoises are widely dispersed from New Jersey to Maine, with lower densities farther north and south. From January to March, intermediate densities of harbor porpoises are found in waters off New Jersey to North Carolina, and lower densities are found in waters off New York to New Brunswick, Canada (Waring et al., 2016).

Unlike other cetacean species that use the Gulf of Maine and Bay of Fundy in the summer, harbor porpoises do not appear to have seasonal migrations or well-defined migration routes in the region (LaBrecque et al., 2015b). Some portion of the population is thought to use the region year-round (National Marine Fisheries Service, 2014; National Oceanic and Atmospheric Administration, 2015). Satellite tagging from 1994 and 1995 showed that some harbor porpoises were commonly found in the waters around the 92-m isobath, suggesting that this area may be used for migrations from the Bay of

Fundy to the lower Gulf of Maine (Read & Westgate, 1997); however, additional data are needed to verify the species' movement patterns.

For additional information about harbor porpoise habitats and geographic range, see Section 3.7.2.3.27.2 (Habitat and Geographic Range).

5.4.2.1.3 Humpback Whales

One area in the AFTT Study Area was identified by LaBrecque et al. (2015b) as a biologically important area for humpback whale feeding from March to December. The feeding area includes the Gulf of Maine, Stellwagen Bank, and the Great South Channel. It has been substantiated through photo-identification data, aerial and vessel survey data, radio tracking data, and expert judgment (LaBrecque et al., 2015b).

Humpback feeding habitats are typically shallow banks or ledges with high seafloor relief (Hamazaki, 2002; Payne et al., 1990a). In the western North Atlantic, humpback whales feed during spring, summer and fall over a large geographic range that includes the Gulf of Maine, Gulf of St. Lawrence, Newfoundland Grand Banks, Labrador Sea, West Greenland, and Scotian Shelf (Cetacean and Turtle Assessment Program, 1982; Kenney & Winn, 1986; Stevick et al., 2006; Whitehead, 1982). Roberts et al. (2016) habitat-based density modeling depicted the areas of highest occurrence to be located south of Jeffreys Ledge, including Stellwagen Bank, the Great South Channel, and western Georges Bank.

Humpback whale ecology in the Gulf of Maine has been studied since the mid-1970s (Clapham & Mayo, 1987; Clapham & Mattila, 1990; Clapham et al., 1993; Hazen et al., 2009; Payne et al., 1986; Weinrich et al., 1997; Weinrich & Kuhlberg, 1991). The Gulf of Maine stock of humpback whales was designated as a separate feeding stock based on the strong site fidelity displayed by individual whales within the region (Waring et al., 2016). Humpback whales feed in the Gulf of Maine from March through December, with most feeding activity observed in June and July. Humpback whale distribution in this region has been largely correlated to abundance of prey species, although behavior and bathymetry are factors influencing foraging strategy (Payne et al., 1990b). Humpback whales are frequently piscivorous when in New England waters, feeding on herring (*Clupea harengus*), sand lance (*Ammodytes* spp.), and other small fishes. In the northern Gulf of Maine, euphausiids are also a frequent prey item (Paquet et al., 1997). Payne et al. (1986) suggested that an increase in the number of humpback whale sightings in the southwest Gulf of Maine since 1978 was concurrent with an increase in the number of sand lance in the same area. However, a significant correlation between humpback whale sightings on Georges Bank where sand lance was abundant was not found. Researchers found that environmental factors, such as topography, combined with foraging behavior (and not solely prey distribution) influence humpback whale feeding distribution (Payne et al., 1986).

For additional information about humpback whale habitats and geographic range, see Section 3.7.2.3.1.2 (Habitat and Geographic Range).

5.4.2.1.4 Minke Whales

Two areas in the AFTT Study Area were identified as biologically important areas for minke whale feeding from March to November by LaBrecque et al. (2015b): (1) Central Gulf of Maine around Parker Ridge and Cashes Ledges, and (2) waters shallower than 200-m in the southern and southwestern section of the Gulf of Maine, including Georges Bank, the Great South Channel, Cape Cod Bay, Massachusetts Bay, Stellwagen Bank, Cape Anne, and Jeffreys Ledge. Identification of these areas was substantiated through vessel-based survey data and expert judgment (LaBrecque et al., 2015b).

Minke whales are most abundant in New England waters from May through September, including the Gulf of Maine, Cape Cod Bay, Great South Channel, and Georges Bank (Waring et al., 2016). Year-round acoustic monitoring in Stellwagen Bank (2006 and 2007–2010) detected minke whale vocalizations from August to mid-November, with 88 percent of detections made in September and October and only a few detections made from March to June (Risch et al., 2013). Minke whales appear to be largely absent in New England waters in winter (LaBrecque et al., 2015b; Risch et al., 2013). Roberts et al. (2016) habitat-based density modeling depicts a markedly higher density of minke whales in these areas from April through October.

Minke whales have been observed feeding in the Great South Channel and adjacent waters from March through November (LaBrecque et al., 2015b). During vessel-based surveys from 1988 to 2011, the Provincetown Center for Coastal Studies recorded 19 sightings of individual minke whales feeding in waters shallower than 150 m along the northern edge of Georges Bank, Great South Channel, and Stellwagen Bank, and off Race Point, Massachusetts (LaBrecque et al., 2015b). From 1998 to 2009, the Northeast Fisheries Science Center aerial survey team recorded 15 sightings of minke whales feeding during all survey months (March to July and October) in waters shallower than 200 m (LaBrecque et al., 2015b). Twenty-one observations of surface feeding were recorded from March through September during surveys within the 100-m isobath in the Great South Channel, along Cape Anne, and at Jeffreys Ledge (Cetacean and Turtle Assessment Program, 1982). Between 1979 and 1992, there were 27 confirmed sightings of minke whales surface feeding in Cape Cod Bay, Massachusetts Bay, and at Stellwagen Bank (Murphy, 1995). Feeding group size was recorded in 24 of the 27 sightings. Two sightings were of pairs, one sighting was of three individuals, and the remaining sightings were of single individuals.

For additional information about minke whale habitats and geographic range, see Section 3.7.2.3.2.2 (Habitat and Geographic Range).

5.4.2.1.5 North Atlantic Right Whales

One area in the AFTT Study Area has been designated by NMFS as critical habitat for North Atlantic right whale feeding, which includes the Gulf of Maine and Georges Bank region. As described in Section 3.7.2.2.2.2 (Habitat and Geographic Range), NMFS designated the critical habitat in 2016 to replace two smaller critical habitats that had been previously designated in 1994. Overlapping this critical habitat are four areas that were identified by LaBrecque et al. (2015b) as biologically important areas for North Atlantic right whales: (1) a feeding area on Jeffreys Ledge (June through July, October through December), (2) feeding areas in Cape Cod Bay and Massachusetts Bay (February through April), (3) feeding areas in the Great South Channel and the northern edge of Georges Bank (April through June), and (4) a migration area (November through December, March through April).

North Atlantic right whales primarily feed on copepods (a type of zooplankton) (Jefferson et al., 2015; Waring et al., 2016) off the northeastern United States between February and December (Baumgartner & Mate, 2003; Baumgartner et al., 2003; Kenney et al., 1986; Weinrich et al., 2000). North Atlantic right whales arrive in Cape Bod Bay and Massachusetts Bay to feed in late winter, with peak abundance in March and April (Hamilton & Mayo, 1990; Mayo et al., 2004; National Oceanic and Atmospheric Administration, 2012). Passive acoustic monitoring studies indicate that North Atlantic right whale presence and calls are persistent in Massachusetts Bay throughout most of the year, except during July and August (Morano et al., 2012a; Mussoline et al., 2012). Call rates have been found to be highest from January through May with a peak in April (Mussoline et al., 2012).

Aerial surveys conducted by NMFS and the Provincetown Center for Coastal Studies in the springs of 1999–2006 found North Atlantic right whales along the northern edge of Georges Bank, in the Great South Channel, in Georges Basin, and in various locations in the Gulf of Maine. The sightings data show that North Atlantic right whales display a strong seasonal occurrence in these areas (Pace & Merrick, 2008). Most spring feeding in the Great South Channel and northern edge of Georges Bank takes place from April to June with a peak in May (Cetacean and Turtle Assessment Program, 1982; Kenney et al., 1995). Tagged North Atlantic right whales have been found to forage at the surface and near the seafloor in the Great South Channel, depending on copepod depth in the water column (Baumgartner et al., 2011; Winn et al., 1995).

Individual North Atlantic right whales and mother-calf pairs depart the Great South Channel for the Bay of Fundy and Roseway Basin in late summer and fall (Brown et al., 2009). During this time, whales have been observed feeding at Jeffreys Ledge in the western Gulf of Maine. Recorded feeding activity at Jeffreys Ledge has been compiled from Cetacean and Turtle Assessment Program (1982) surveys, whale-watching trips, and the North Atlantic right whale sightings database. Each source of data recognized two seasonal peaks: summer sightings from July to August primarily of mother-calf pairs, and fall sightings from October to December of all age classes. Jeffreys Ledge may serve as a stopover feeding area, especially for whales transiting between more northerly waters (Weinrich et al., 2000). Sightings at Jeffreys Ledge peak between October and November (Weinrich et al., 2000; Weinrich et al., 2005). Skim feeding and near-surface feeding have been observed during the fall (Longley, 2012; Weinrich et al., 2000). Acoustic monitoring at Jeffreys Ledge (2004–2005) has detected North Atlantic right whale calls from November to May, with the highest call rates from November to February (Mussoline et al., 2012). More dedicated surveys during the fall and early winter, as well as studies of the physical and oceanographic characteristics of Jeffreys Ledge, would provide more insight into the importance of this area as habitat for North Atlantic right whales (Weinrich et al., 2000).

In addition to the feeding areas, one location in the AFTT Study Area was identified by LaBrecque et al. (2015b) as a biologically important area for North Atlantic right whale mating based on a demographic comparison of North Atlantic right whale habitats conducted by Cole et al. (2013). The mating area is in the central Gulf of Maine and includes the Outer Falls and Cashes Ledge. Some North Atlantic right whales (mostly pregnant females and juveniles) return to the calving grounds off the southeastern United States in December and January, but the location of the rest of the population during the winter months is currently unknown. It is believed that the remaining population resides in the cold, offshore waters off the northeastern United States where prey availability is high (Bort et al., 2015). Research suggests that North Atlantic right whales are present in the Gulf of Maine throughout the winter and may be using the central Gulf of Maine, including Outer Falls and Cashes Ledge, as a potential mating area (Bort et al., 2015; Cole et al., 2013). Cole et al. (2013) found that North Atlantic right whales aggregate in the central Gulf of Maine during their believed conception period from November to January. A large number of reproductively successful males and females occur in this area during these months, when compared to other regions that were analyzed, such as the Bay of Fundy, Great South Channel, and Jeffreys Ledge. About half of the North Atlantic right whale population was sighted in this area between 2002 and 2008. Slightly less than half the individuals were identified as males, including some that were known fathers. Passive acoustic monitoring conducted by Bort et al. (2015) also showed that the central Gulf of Maine is a seasonally important habitat for right whales, with male display and mating behaviors possibly occurring at high rates in this area. Cole et al. (2013) does not refute the idea of conception possibly occurring outside of the identified mating area during the believed conception period, or that this population may have another mating area that has yet to be identified. Longley

(2012) proposed that in addition to feeding, North Atlantic right whales may use Jeffreys Ledge for mating. The timing of North Atlantic right whale sightings at Jeffreys Ledge corresponds with the timing of when mating is believed to occur (Kraus et al., 2007); however, mating activities in this area have yet to be confirmed. A longer term dataset is needed to better understand how North Atlantic right whales use the central Gulf of Maine for mating (Cole et al., 2013).

LaBrecque et al. (2015b) also identified a biologically important area for North Atlantic right whale migration off the U.S. Atlantic coast from November through December and March through April. Section 5.4.3.1.3 (North Atlantic Right Whales) presents a discussion of the southern portion of the migration habitat. In the northeast, the migration habitat overlaps a portion of the northeastern North Atlantic right whale critical habitat and feeding areas. North Atlantic right whales undertake large seasonal migrations. LaBrecque et al. (2015b) identified a migratory corridor along the East Coast of the United States. The migratory corridor is used by North Atlantic right whales during southward migrations in November and December to calving grounds, and northward migrations in March and April to feeding areas, the Bay of Fundy, and other unknown areas (Kenney, 2008; Roberts et al., 2016; Whitt et al., 2013). The subset of the population that has been observed migrating between the northern feeding grounds and southern calving grounds includes reproductively mature and pregnant females, juveniles, and young calves (Federal Register 81 [17]: 4838-4874). North Atlantic right whales are believed to migrate along the continental shelf (Schick et al., 2009; Whitt et al., 2013); however, it is unknown if the whales use the whole shelf area or just the nearshore waters (LaBrecque et al., 2015b). Tagging results from an analysis by Schick et al. (2009) suggest that the migratory corridor is broader than was initially estimated, and that suitable habitat exists beyond 20 NM from the coast, a distance that is presumed to represent the primary migratory pathway (National Marine Fisheries Service, 2008). NMFS has not defined critical habitat for North Atlantic right whale migration due to the lack of information on migratory routes and the lack of data needed to identify essential physical and biological features (Federal Register 81 [17]: 4838-4874).

For additional information about North Atlantic right whale habitats and geographic range, see Section 3.7.2.2.2.2 (Habitat and Geographic Range).

5.4.2.1.6 Sei Whales

One area in the AFTT Study Area was identified as a biologically important area for sei whale feeding from May to November by LaBrecque et al. (2015b). The identification of this area was substantiated thorough vessel and aerial survey data, feeding information from commercial whale watching trips, and expert judgment (LaBrecque et al., 2015b). The area extends from the 25-m contour off coastal Maine and Massachusetts to the 200-m contour in the central Gulf of Maine, including the northern shelf break area of Georges Bank. The feeding area also includes the southern shelf break area of Georges Bank from 100–2,000 m and the Great South Channel.

The sei whale is the only rorqual species that seems to have evolved the ability to capture prey both by engulfment (as do the other rorquals) or by skimming on relatively low prey concentrations (as do North Atlantic right whales and bowhead whales) (Prieto et al., 2012). This adaptation is reflected in the variety of prey recorded for the species. The sei whale has the most extensive diet of any baleen whale, which includes copepods, euphausiids, amphipods, decapods, cephalopods, and fish. Prey preferences are highly dependent on ocean basin and swarming characteristics of the prey (Prieto et al., 2012). Sei whales in the North Atlantic are largely planktivorous, feeding primarily on copepods, and secondarily on euphausiids (Baumgartner et al., 2011; Cetacean and Turtle Assessment Program, 1982; Flinn et al., 2002; Jonsgard & Darling, 1977; Kenney & Winn, 1986; Mizroch et al., 1984b; Prieto et al., 2012).

Baumgartner et al. (2011) suggest that the distribution and vertical migrations of copepods influence the distribution, abundance, and calling behaviors of sei whales in the southwestern Gulf of Maine. Baumgartner and Fratantoni (2008) found that sei whale calling rates increased during the day when vertically migrating copepods were at depth and decreased at night when the copepods had migrated to the surface. Sei whales may be unable to feed on deep layers of copepods, and their increased calling behavior during the day may be associated with a reduction in feeding on copepods and an increase in socializing with conspecifics or switching to a different prey species (Baumgartner & Fratantoni, 2008).

Sei whales were once believed to visit the inshore waters of the Gulf of Maine (including the Great South Channel) only occasionally in response to increases in the availability of copepods (Payne et al., 1990b; Schilling et al., 1992). However, Baumgartner et al. (2011) found sei whales to be reasonably common in the Great South Channel in most years. Sightings from the Cetacean and Turtle Assessment Program (1982) and data from NMFS shipboard surveys (Waring et al., 2014) found peak abundances of sei whales in U.S. Atlantic waters in spring. This was particularly true along the shelf break of Georges Bank, into the Northeast Channel, and southwest to Hydrographer Canyon. Roberts et al. (2016) habitat-based density modeling depicts the highest sei whale densities in the LaBrecque et al. (2015b)-identified feeding areas in May and June. LaBrecque et al. (2015b) suggested that feeding activity in U.S. Atlantic waters was concentrated from May to November, with a peak in July and August; however, the authors did not specify locations.

For additional information about sei whale habitats and geographic range, see Section 3.7.2.2.5.2 (Habitat and Geographic Range).

5.4.2.2 Mitigation Area Assessment

When developing Phase III mitigation, the Navy analyzed the potential for increasing mitigation areas in the Study Area. Based on its ongoing analysis of the best available science and potential mitigation measures, the Navy determined it can implement additional mitigation measures off the northeastern United States under the Proposed Action to enhance protection of marine mammals (including North Atlantic right whales) to the maximum extent practicable. In addition to evaluating areas for marine mammals, the Navy assessed the potential for developing mitigation areas for explosives within Habitat Areas of Particular Concern for sandbar and sand tiger sharks. The Navy does not plan to conduct training or testing activities involving explosives in sandbar and sand tiger shark Habitat Areas of Particular Concern off the northeastern United States; therefore, mitigation for explosives within these areas is not warranted.

New mitigation developed for Phase III includes: (1) enlarging the Northeast North Atlantic Right Whale Mitigation Area to cover the full extent of the northeast North Atlantic right whale critical habitat, (2) developing new special reporting requirements for the use of active sonar and in-water explosives within the Northeast North Atlantic Right Whale Mitigation Area, and (3) developing a new mitigation area known as the Gulf of Maine Planning Awareness Mitigation Area to limit hull-mounted mid-frequency active sonar hours, not conduct major training exercises, and implement special reporting requirements for the use of active sonar and in-water explosives. The remaining mitigation measures presented in Table 5.4-2 are continuations from Phase II.

Mitigation areas off the northeastern United States will avoid or reduce impacts on one or more marine mammal species or stocks and their habitat, as summarized below:

- **Northeast North Atlantic Right Whale Mitigation Area.** The Navy has enlarged the mitigation area to cover the full extent of the northeast North Atlantic right whale critical habitat.

Mitigation to limit the use of active sonar to the maximum extent practicable and not use certain explosive and non-explosive munitions will help the Navy further avoid or reduce potential impacts on North Atlantic right whales year-round in their most important feeding areas, a mating area, and the northern portion of their migration habitat. Conducting non-explosive torpedo activities during daylight hours in Beaufort sea state 3 or less will help increase Lookout effectiveness during these activities. Mitigation to obtain the latest sighting information from the North Atlantic Right Whale Sighting Advisory System will help vessels avoid North Atlantic right whales during training and testing activities. The North Atlantic Right Whale Sighting Advisory System is a National Oceanographic and Atmospheric Administration program that collects sightings information off the northeastern United States from aerial surveys, shipboard surveys, whale watching vessels, and opportunistic sources, such as the U.S. Coast Guard, commercial ships, fishing vessels, and the public. By expanding the size of the Northeast North Atlantic Right Whale Mitigation Area, the Navy will avoid or reduce potential impacts on other marine mammal species within key areas of biological importance, such as humpback whale, minke whale, sei whale, and fin whale feeding areas and a small and resident population of harbor porpoises. The Navy will also implement new special reporting procedures to report the total hours and counts of active sonar and in-water explosives used in the mitigation area in its annual training and testing activity reports submitted to NMFS. The special reporting requirements will aid the Navy and NMFS in continuing to analyze potential impacts of training and testing in this area.

- **Gulf of Maine Planning Awareness Mitigation Area.** Newly developed for Phase III, the Gulf of Maine Planning Awareness Mitigation Area extends throughout the Gulf of Maine and southward over Georges Bank. The mitigation will further help the Navy avoid or reduce potential impacts on marine mammals from active sonar during major training exercises within key areas of biological importance, including North Atlantic right whale critical habitat; a portion of the northern North Atlantic right whale migration area; North Atlantic right whale, humpback whale, minke whale, sei whale, and fin whale feeding areas; a North Atlantic right whale mating area; and a small and resident population of harbor porpoises. The Navy will also implement special reporting procedures to report the total hours and counts of active sonar and in-water explosives used in the mitigation area in its annual training and testing activity reports submitted to NMFS. The special reporting requirements will aid the Navy and NMFS in continuing to analyze potential impacts of training and testing in this area.
- **Northeast Planning Awareness Mitigation Areas.** The Northeast Planning Awareness Mitigation Areas extend across the shelf break and contain underwater canyons that have been associated with marine mammal feeding and abundance, including within a portion of the Northeast Canyons and Seamounts National Marine Monument. They are situated among highly productive environments, such as persistent oceanographic features associated with upwellings and steep bathymetric contours. Continuing the mitigation within the Northeast Planning Awareness Mitigation Areas will help the Navy further avoid or reduce potential impacts from active sonar during major training exercises on marine mammals that inhabit, feed in, mate in, or migrate through the northeast region. For example, the mitigation areas overlap a portion of the North Atlantic right whale northern migration habitat. Fin whales are known to follow prey off the continental shelf in this region (Azzellino et al., 2008; Panigada et al., 2008). Sei whales have high abundance in two of the mitigation areas along the shelf break of Georges Bank and near Hydrographer Canyon (Waring et al., 2014).

The Navy conducts training and testing activities off the northeastern United States because this region provides valuable access to sea space and airspace conditions analogous to areas where the Navy operates or may need to operate in the future. The Navy uses the Northeast Range Complexes and adjacent waters to support torpedo exercises, tracking exercises, Civilian Port Defense – Homeland Security Anti-Terrorism/Force Protection exercises, missile and rocket exercises, Maritime Security Operations – Anti-Swimmer Grenades activities, gunnery exercises, submarine sonar maintenance and system checks, kilo dip tests, at-sea sonar testing, and other air warfare, anti-submarine warfare, mine warfare, expeditionary warfare, and surface warfare activities. The Navy also performs acoustic and oceanographic research in continental shelf areas off the northeastern United States. Research involves active acoustic transmissions used for engineering tests of acoustic sources, validation of ocean acoustic models, tests of signal processing algorithms, and characterization of acoustic interactions with the seafloor.

Training and testing schedules are based on national tasking, the number and duration of training cycles identified in the Optimized Fleet Response Plan and other training plans, forecasting of future testing requirements, and emerging requirements. When scheduling activities, the Navy considers the need to minimize sea space and airspace conflicts within the northeast region and throughout the entire Study Area. For example, the Navy schedules training and testing to minimize conflicts between its own activities and with consideration for public safety (e.g., safe distances from commercial or recreational fishing activities). Daily fluctuations in training and testing schedules and objectives could mean that, on any given day, vessels or aircraft may depend on discrete locations of sea space or airspace off the northeastern United States for discrete purposes.

The Navy selects training areas in this region to allow for the realistic tactical development of the myriad training scenarios that Navy units are required to complete to be mission effective. For example, the topography and bathymetry in this region consists of a wide continental shelf leading to the shelf break, which affords a wide range of opportunities to plan and execute training exercises to certify forces to deploy. The Navy selects the locations (e.g., pierside in Boston, Massachusetts) and scenarios for Civilian Port Defense – Homeland Security Anti-Terrorism/Force Protection exercises according to Department of Homeland Security strategic goals and evolving world events. The Navy chooses locations for other training activities based on proximity to training ranges (e.g., Boston Operating Area), available airspace (e.g., warning area W-107A in the Atlantic City Range Complex), unobstructed sea space (e.g., throughout the Narragansett Bay Operating Area), and aircraft emergency landing fields (e.g., Quonset Point Air National Guard Base, Quonset Point, Rhode Island).

The Navy conducts testing activities in the northeast region because it provides a variety of bathymetric and environmental conditions necessary to ensure functionality and accuracy of systems and platforms in areas analogous to where the military operates. Testing locations are typically located near systems command support facilities, which provide critical safety, platform, and infrastructure support and technical expertise necessary to conduct testing (e.g., proximity to air squadrons). The Naval Undersea Warfare Center Division, Newport Testing Range provides critical sea space for the use of active sonar during Anti-Submarine Warfare Mission Package Testing events and other testing activities. The Navy has used the same torpedo testing areas in this region for decades because these areas provide critical bathymetric features and consistency for comparative data collection.

The Navy selects locations for acoustic and oceanographic research in the northeast because this region has ideal water depths for important research on shallow-water acoustic propagation. The northeast also has seafloor types that are of particular interest for ocean acoustics research and an abundance of three-dimensional bathymetric phenomena (e.g., Hudson Canyon). The region provides unique opportunities for the Navy to conduct acoustic and oceanographic research experiments to observe systems with different acoustic parameters (e.g., frequency, directionality, signal) under a variety of environmental conditions (e.g., wind, waves, pre- and post-storms). The Northeast Range Complexes provide one of the most appropriate environments to test mine countermeasure systems during Emerging Mine Countermeasure Technology Research events, when considering how mine systems would be used by an adversary. Logistical support for acoustic and oceanographic research experiments is available from university research vessels and the Naval Undersea Warfare Center Division, Newport.

The Navy requires flexibility in the timing of its use of active sonar and explosives in order to meet individual training and testing schedules and deployment schedules. Navy vessels, aviation squadrons, and testing programs have a limited amount of time available for training and testing. The Navy must factor in variables such as maintenance and weather when scheduling event locations and timing. Major training exercise locations may have to change during an exercise or during exercise planning based on assessments of unit performance or other conditions, such as weather and mechanical issues. This precludes the ability to completely prohibit major training exercises from occurring in this region. The schedules of other training activities, such as explosive missile exercises, are driven by deployment requirements and national command authority assignments.

The testing community is required to install and test systems on platforms at the locations where those platforms are stationed. Testing associated with new construction ships must occur in locations close to the shipbuilder's facilities in the northeast for reasons associated with construction schedule, proximity to testing ranges and facilities, and safety. Additionally, the testing community has a need for rapid development to quickly resolve tactical deficiencies. For example, due to its positioning within the boundary of the Naval Undersea Warfare Center Division, Newport Testing Range, the Navy will not develop a mitigation area for one of the habitats considered in Section 5.4.2.1 (Resource Description), the area east of Montauk Point that was identified by LaBrecque et al. (2015b) as a biologically important area for fin whale feeding. Overall, training and testing schedules can be cyclical and are partially driven by geo-political situations, which precludes the Navy from implementing additional mitigation to reduce or eliminate the use of active sonar or explosives off the northeastern United States.

The Navy determined that enlarging the Northeast North Atlantic Right Whale Mitigation Area to cover the full extent of the northeast North Atlantic right whale critical habitat, developing the new Gulf of Maine Planning Awareness Mitigation Area, and continuing the mitigation within the Northeast Planning Awareness Mitigation Areas as described in Table 5.4-2 would be practical to implement under the Proposed Action. This determination was based on an operational assessment of past use of active sonar, explosives, and non-explosive practice munitions; projected future training and testing needs in the region; and consideration of fleet concentration areas in the Study Area. The mitigation areas off the northeastern United States as described in Table 5.4-2 represent the largest areas and highest level of mitigation within each area that is practical for the Navy to implement within this region under the Proposed Action. Further modifications of training and testing activities off the northeastern United States would have a significant impact on safety, sustainability, and the Navy's ability to meet its mission requirements.

Expanding the mitigation areas in this region would encroach upon the primary water space where training and testing activities are scheduled to occur. Implementing additional mitigation off the northeastern United States would have a significant impact on the ability for units to meet their individual training and certification requirements (impacting the ability to deploy with the required level of readiness necessary to accomplish their missions), to certify forces to deploy to meet national security tasking (limiting the flexibility of Combatant Commanders and warfighters to project power, engage in multi-national operations, and conduct the full range of naval warfighting capability in support of national security interests), and for program managers and weapons system acquisition programs to meet testing requirements and required acquisition milestones. Based on the Navy's assessment, additional mitigation in this region would increase operational costs (due to extending distance offshore, which would increase fuel consumption, maintenance, and time on station to complete required training and testing activities), increase safety risks (associated with conducting training and testing at extended distances offshore and farther away from critical medical and search and rescue capabilities), and accelerate fatigue-life of aircraft and ships (leading to increased safety risk and higher maintenance costs). Furthermore, additional mitigation would significantly impact training and testing realism due to reduced access to necessary environmental or oceanographic conditions that replicate military mission and combat conditions. This would diminish the ability for Navy Sailors to train and become proficient in using sensors and weapon systems as required during military missions and combat operations. Prohibiting or modifying certain activities, such as Civilian Port Defense – Homeland Security Anti-Terrorism/Force Protection exercises, would also result in impacts on national security.

The iterative and cumulative impact of all potential mitigation measures the Navy assessed, including certain mitigation measures suggested through public comments on the Draft EIS/OEIS, would deny national command authorities the flexibility to respond to national security challenges and effectively accomplish the training necessary for deployment. For example, additional limitations on the use of active sonar and explosives off the northeastern United States would require the Navy to shift its training activities to alternative locations farther offshore, farther south along the Eastern seaboard, or to the Gulf of Mexico. This would have significant impacts on safety, sustainability, and the ability to meet mission requirements within limited available timeframes. Likewise, requiring weapons system program managers and research, testing, and development program managers to use alternative areas within limited available timeframes would deny them the necessary flexibility to rapidly field or develop systems to meet testing program requirements and emerging requirements.

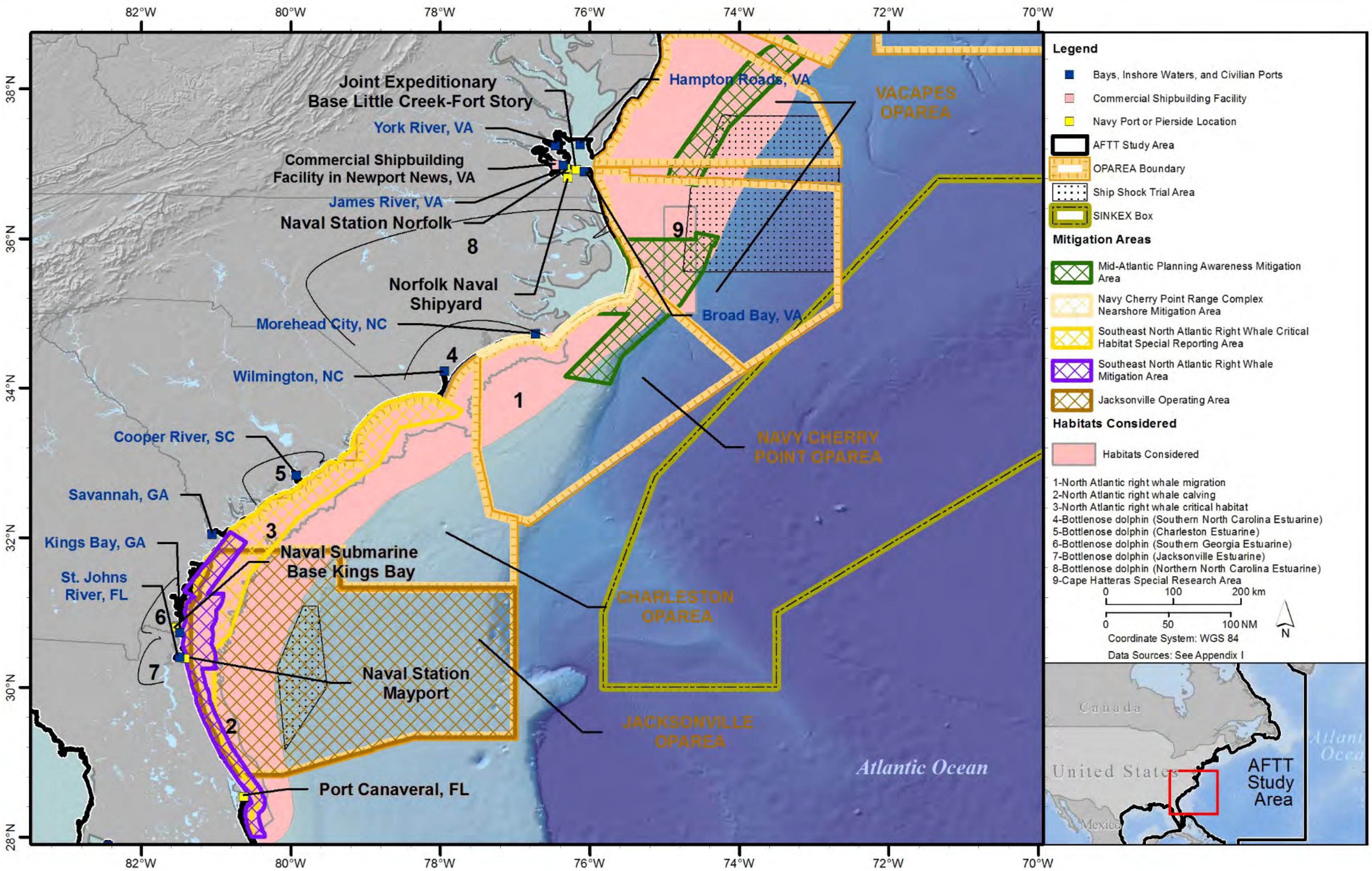
In summary, the Navy developed the mitigation areas identified in Table 5.4-2 to provide further protection for marine mammals in areas the best available science suggests are important for foraging, migrating, and reproduction. The mitigation will help the Navy avoid or reduce potential impacts on harbor porpoises and fin, humpback, minke, North Atlantic right, and sei whales within the mitigation areas. Further restrictions off the northeastern United States on the level, number, or timing (seasonal or time of day) of training and testing activities would be impractical to due implications for safety, sustainability, and mission requirements.

5.4.3 Mitigation Areas off the Mid-Atlantic and Southeastern United States

As described in Table 5.4-3 and shown in Figure 5.4-5, the Navy will implement mitigation within mitigation areas off the mid-Atlantic and southeastern United States to, in combination with procedural mitigation, effect the least practicable adverse impact on marine mammal species or stocks and their habitat and to avoid or reduce potential impacts on sea turtles and sandbar sharks.

Table 5.4-3: Mitigation Areas off the Mid-Atlantic and Southeastern United States

Mitigation Area Description
Stressor or Activity • Sonar • Explosives • Physical disturbance and strikes
Resource Protection Focus • Marine mammals • Sea turtles • Fish (sandbar sharks)
Mitigation Area Requirements • **Southeast North Atlantic Right Whale Mitigation Area (November 15 through April 15):** – The Navy will report the total hours and counts of active sonar and in-water explosives used within the mitigation area in its annual training and testing activity reports submitted to NMFS. – The Navy will not conduct: (1) low-frequency active sonar (except as noted below), (2) mid-frequency active sonar (except as noted below), (3) high-frequency active sonar, (4) missile and rocket activities (explosive and non-explosive), (5) small-, medium-, and large-caliber gunnery activities, (6) Improved Extended Echo Ranging sonobuoy activities, (7) explosive and non-explosive bombing activities, (8) in-water detonations, and (9) explosive torpedo activities within the mitigation area. – To the maximum extent practicable, the Navy will minimize the use of: (1) helicopter dipping sonar, (2) low-frequency active sonar and hull-mounted mid-frequency active sonar used for navigation training, and (3) low-frequency active sonar and hull-mounted mid-frequency active sonar used for object detection exercises within the mitigation area. – Before transiting or conducting training or testing activities within the mitigation area, the Navy will initiate communication with the Fleet Area Control and Surveillance Facility, Jacksonville to obtain Early Warning System North Atlantic right whale sightings data. The Fleet Area Control and Surveillance Facility, Jacksonville will advise vessels of all reported whale sightings in the vicinity to help vessels and aircraft reduce potential interactions with North Atlantic right whales. Commander Submarine Force U.S. Atlantic Fleet will coordinate any submarine activities that may require approval from the Fleet Area Control and Surveillance Facility, Jacksonville. Vessels will use the sightings information to reduce potential interactions with North Atlantic right whales during transits. – Vessels will implement speed reductions after they observe a North Atlantic right whale, if they are within 5 NM of a sighting reported within the past 12 hours, or when operating in the mitigation area at night or during periods of poor visibility. – To the maximum extent practicable, vessels will minimize north-south transits in the mitigation area. • **Jacksonville Operating Area (November 15 through April 15):** – Navy units conducting training or testing activities in the Jacksonville Operating Area will initiate communication with the Fleet Area Control and Surveillance Facility, Jacksonville to obtain Early Warning System North Atlantic right whale sightings data. The Fleet Area Control and Surveillance Facility, Jacksonville will advise vessels of all reported whale sightings in the vicinity to help vessels and aircraft reduce potential interactions with North Atlantic right whales. Commander Submarine Force U.S. Atlantic Fleet will coordinate any submarine activities that may require approval from the Fleet Area Control and Surveillance Facility, Jacksonville. The Navy will use the reported sightings information as it plans specific details of events (e.g., timing, location, duration) to minimize potential interactions with North Atlantic right whales to the maximum extent practicable. The Navy will use the reported sightings information to assist visual observations of applicable mitigation zones and to aid in the implementation of procedural mitigation. • **Southeast North Atlantic Right Whale Critical Habitat Special Reporting Area (November 15 through April 15):** – The Navy will report the total hours and counts of active sonar and in-water explosives used within the Special Reporting Area (i.e., southeast North Atlantic right whale critical habitat) in its annual training and testing activity reports submitted to NMFS. • **Mid-Atlantic Planning Awareness Mitigation Areas (year-round):** – The Navy will avoid conducting major training exercises within the mitigation area (Composite Training Unit Exercises or Fleet Exercises/Sustainment Exercises) to the maximum extent practicable. – The Navy will not conduct more than four major training exercises per year (all or a portion of the exercise) within the mitigation area. If the Navy needs to conduct additional major training exercises in the mitigation area in support of training requirements driven by national security concerns, it will provide NMFS with advance notification and include the information in its annual training and testing activity reports submitted to NMFS. • **Navy Cherry Point Range Complex Nearshore Mitigation Area (March through September):** – The Navy will not conduct explosive mine neutralization activities involving Navy divers in the mitigation area. – To the maximum extent practicable, the Navy will not use explosive sonobuoys, explosive torpedoes, explosive medium-caliber and large-caliber projectiles, explosive missiles and rockets, explosive bombs, explosive mines during mine countermeasure and neutralization activities, and anti-swimmer grenades in the mitigation area.



Notes: AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area; SINKEX: sinking exercise; VACAPES: Virginia Capes

Figure 5.4-5: Mitigation Areas and Habitats Considered off the Mid-Atlantic and Southeastern United States

5.4.3.1 Resource Description

The Navy assessed the mid-Atlantic and southeastern United States region for potential mitigation areas. The assessment included, but was not limited to, the following areas that have been established by NMFS as critical habitat or habitat with high marine mammal abundance, or identified by LaBrecque et al. (2015b) as biologically important areas (as shown in Figure 5.4-5 and described in the sections below):

- Bottlenose dolphin Northern North Carolina Estuarine System small and resident population (year-round)
- Bottlenose dolphin Southern North Carolina Estuarine System small and resident population (year-round)
- Bottlenose dolphin Charleston Estuarine System small and resident population (year-round)
- Bottlenose dolphin Southern Georgia Estuarine System small and resident population (year-round)
- Bottlenose dolphin Jacksonville Estuarine System small and resident population (year-round)
- Cape Hatteras Special Research Area (year-round)
- North Atlantic right whale critical habitat (southeastern U.S. calving area; mid-November through late April)
- North Atlantic right whale calving habitat in the southeast Atlantic (mid-November through late April)
- North Atlantic right whale migratory corridor along the U.S. East Coast (southern portion) (November through December, March through April)

The primary focus of the mitigation area assessment was for marine mammals; however, because the Navy assessed sea space throughout the region, many of the geographic areas considered for marine mammals are also known to be inhabited by non-marine mammal species, such as sea turtles. For example, the Navy assessed the potential for developing mitigation areas within nearshore habitats along the coast of North Carolina, which are inhabited by marine mammals, sea turtles, sharks, and a variety of other marine species.

5.4.3.1.1 Bottlenose Dolphins

Five areas that overlap the AFTT Study Area were identified by LaBrecque et al. (2015b) as biologically important areas for small and resident populations of bottlenose dolphins along the U.S. East Coast: (1) the Northern North Carolina Estuarine System Population, (2) the Southern North Carolina Estuarine System Population, (3) the Charleston Estuarine System Population, (4) the Southern Georgia Estuarine System Population, and (5) the Jacksonville Estuarine System Population. The areas were recognized through various methods, including photo-identification, vessel surveys, satellite tagging, and genetic analyses. The small and resident populations are individual stocks that use coastal waters as important reproductive, migration, and feeding areas.

The bottlenose dolphin coastal morphotype is continuously distributed along the U.S. East Coast south of Long Island, New York, around the Florida peninsula, and along the Gulf of Mexico coast. Although the structure of the individually recognized stocks is somewhat uncertain, it appears to be complex. Not every portion of the coast appears to be a significantly important bottlenose dolphin habitat; however, scientific evidence suggests that important breeding grounds, migration habitat, and foraging grounds for the individually recognized bottlenose dolphin coastal morphotypes are scattered throughout coastal waters. The Charleston Estuarine System Population has high site fidelity based on data collected through photo-identification, remote biopsy, capture-release, and radio-tracking (Speakman et al., 2006). Within the Charleston Estuarine System population, 839 animals have been individually identified, with 115 animals being observed up to 10 times over periods up to 10 years. The Southern Georgia Estuarine System Population also has high genetic and site fidelity. Further studies are required to better understand the residency patterns of the Northern North Carolina Estuarine System Population, the Southern North Carolina Estuarine System Population, and the Jacksonville Estuarine System Population. Due to ongoing photo-identification studies (including Navy-funded monitoring efforts), the full habitat extent of several of these small and resident populations is subject to change as new information becomes available (LaBrecque et al., 2015b).

For additional information about bottlenose dolphin habitats and geographic range, see Section 3.7.2.3.10.2 (Habitat and Geographic Range).

5.4.3.1.2 Cape Hatteras Special Research Area

NMFS designated the Cape Hatteras Special Research Area as part of the Pelagic Longline Take Reduction Plan in January 2009 (National Marine Fisheries Service, 2009a). The area was designated due to high rates of pilot whale and Risso's dolphin bycatch in the U.S. East Coast Atlantic pelagic longline fishery. Unique oceanographic properties exist in the area due to how the Gulf Stream separates from the continental slope to the deep ocean, and southward-flowing continental shelf waters from the Middle Atlantic Bight converge with northward-flowing continental shelf waters from the South Atlantic Bight. These water flow patterns support upwelling events and high biodiversity, two features that indicate an area could have high value for marine mammal feeding. NMFS management measures for the Cape Hatteras Special Research Area apply to fisheries and not to Navy activities; however, the Navy considered this area due to its potential as an important marine mammal feeding area.

Numerous species of marine mammals occur in the Cape Hatteras Special Research Area, including beaked, fin, humpback, minke, and sperm whales; and pilot whales, bottlenose, short-beaked common, Atlantic spotted, striped, Clymene, and Risso's dolphins. The area is thought to be important for short-finned pilot whale feeding and is associated with high species abundance (Thorne et al., 2017). The area is also used seasonally during migrations by numerous species and overlaps the North Atlantic right whale migration habitat identified by LaBrecque et al. (2015b).

Navy monitoring data supports this area as having high diversity and density of marine mammals, including extremely high encounter rates for beaked whales. The Navy has been conducting aerial and vessel-based surveys off Cape Hatteras since July 2009 and acoustic monitoring since 2011. Between 2009 and 2015, 14 species or species groups were observed during vessel-based surveys, totaling more than 500 animals (Foley et al., 2015). Vessel-based surveys typically took place during the spring, summer, and fall. Aerial surveys were conducted year-round, with one to two survey days per month, depending on weather conditions. During aerial surveys conducted over 16 days in January and December 2015, 13 species were observed, totaling 160 sightings and more than 5,000 individual cetaceans (McAlarney et al., 2016). Species observed included bottlenose, Atlantic spotted, short-beaked common, Risso's, striped, and Clymene dolphins; and short-finned pilot, Cuvier's beaked, True's beaked, sperm, humpback, minke, fin, mesoplodont beaked, and Kogia whales.

Satellite tagging of several deep-diving marine mammal species has also recently been conducted in the Cape Hatteras Special Research Area. In 2015, satellite tags were deployed on bottlenose dolphins, Cuvier's beaked whales, short-finned pilot whales, and short-beaked common dolphins (Baird et al., 2016). In 2017, satellite tags were deployed on short-finned pilot whales and Cuvier's beaked whales (Baird et al., 2018). The findings from these studies indicate that while individuals have varying levels of site fidelity, the continental slope area off Cape Hatteras appears to be an important location for these species. One deep-diving species, the sperm whale, is found east and northeast of Cape Hatteras throughout winter months (Waring et al., 2015). Sperm whales inhabit the area year-round; however, distribution primarily shifts north in the summer. Pilot whales (primarily short-finned) are commonly observed in waters off Cape Hatteras, generally along the continental shelf edge (Waring et al., 2016). Some species, such as Cuvier's beaked whales, remained near the slope within the Cape Hatteras Special Research Area, while other species, such as short-finned pilot whales, traveled into more northern and southern waters before returning to the Cape Hatteras Special Research Area (Baird et al., 2016).

5.4.3.1.3 North Atlantic Right Whales

An area off the southeastern United States has been designated by NMFS as critical habitat for North Atlantic right whale calving. The southern North Atlantic right whale critical habitat includes the coasts of North Carolina, South Carolina, Georgia, and Florida. As described in Section 3.7.2.2.2.2 (Habitat and Geographic Range), NMFS designated the critical habitat in 2016 to replace a smaller critical habitat that had been previously designated in 1994. Overlapping the critical habitat are areas identified by LaBrecque et al. (2015b) as biologically important habitat for North Atlantic right whale calving from mid-November to late April and migration from November through December and March through April.

Waters off the southeastern United States are the primary wintering ground for calving females, other adults, and juvenile North Atlantic right whales. These waters are the only known calving ground for North Atlantic right whales and are used from November to April. North Atlantic right whales typically give birth from December to March (Knowlton et al., 1994; Kraus et al., 2007). Most sightings of neonates and calves have occurred during aerial surveys off southern Georgia and northeastern Florida (Garrison, 2007; Hamilton et al., 2007). During passive acoustic monitoring and visual surveys conducted off Savannah, Georgia and Jacksonville, Florida from 2009–2011, North Atlantic right whales were detected between November and April at both survey locations. More calls and sightings were recorded off Jacksonville than Savannah (Soldevilla et al., 2014). Aerial surveys sponsored by the Navy offshore of Jacksonville, Florida between 2009 and 2016 resulted in the following sightings: (1) a single whale approximately 40 NM offshore, (2) a female giving birth 40 NM offshore in March 2010 (U.S. Department of the Navy, 2011), (3) three whales approximately 20–25 NM offshore, and (4) two whales approximately 10 NM from shore. In the fall and winter of 2009–2010, Navy-sponsored acoustic recorders were deployed between 60–150 kilometers offshore of Jacksonville. Although sightings typically occur most frequently within continental shelf waters from northeastern Florida to southeastern Georgia during the fall and winter, there were no North Atlantic right whale vocalizations detected during this passive acoustic monitoring study (Charif et al., 2015).

Sighting rates within North Atlantic right whale calving habitat have shown a correlation with water temperature and depth. One study found sighting rates to be highest in waters with sea surface temperatures less than 22°C and water depths between 10–20 m (Good, 2008). Gowan and Ortega-Ortiz (2014) found that sea surface temperature and water depth are significant factors in predicting North Atlantic right whale abundance on calving grounds. Using temperature and depth as habitat predictors, calving could occur over continental shelf waters as far north as Cape Lookout, North Carolina (Good, 2008; Keller et al., 2012). Navy-sponsored monitoring conducted off Cape Hatteras, North Carolina in 2011 and in Onslow Bay, North Carolina in 2007 confirmed the winter occurrence of North Atlantic right whales in these areas (U.S. Department of the Navy, 2014). During surveys conducted off the coast of

North Carolina in the winters of 2001 and 2002, researchers sighted eight calves, suggesting that the calving grounds may extend as far north as Cape Fear, North Carolina (Waring et al., 2016). The species has also been observed in winter around Cape Canaveral, Florida (Keller et al., 2006) and off South Carolina (McLellan et al., 2004).

LaBrecque et al. (2015b) used aerial sightings data and habitat analyses of sea surface temperatures and water depths to delineate the North Atlantic right whale calving area as extending from Cape Lookout, North Carolina to Cape Canaveral, Florida. The area encompasses waters from the shoreline to the 25-m isobath from mid-November through late April. Only a few sightings of calves have been reported outside of this area, such as a calf apparently born in the Gulf of Maine in the spring of 2007 (Patrician et al., 2009) and a newborn with its mother sighted off Plymouth Harbor, New England in January 2013 (LaBrecque et al., 2015b).

North Atlantic right whales undertake large seasonal migrations, with some of the population traveling to cold and productive waters during spring and summer to feed, to warmer waters during winter to calve, or to other unknown wintering areas (Kenney, 2008; Roberts et al., 2016; Whitt et al., 2013). LaBrecque et al. (2015b) identified a migratory corridor along the East Coast of the United States that is used by North Atlantic right whales during southward migrations to the calving grounds in November and December, and northward migrations to the feeding areas, the Bay of Fundy, and other unknown areas in March and April. The subset of the population that has been observed migrating between the northern feeding grounds and southern calving grounds includes reproductively mature and pregnant females, juveniles, and young calves (Federal Register 81 [17]: 4838-4874). North Atlantic right whales are believed to migrate along the continental shelf (Schick et al., 2009; Whitt et al., 2013); however, it is unknown if the whales use the whole shelf area, or just the nearshore waters (LaBrecque et al., 2015b). Analysis by Schick et al. (2009) of a tagging survey suggests that the migratory corridor is broader than was initially estimated and that suitable habitat exists beyond 20 NM from the coast, a distance that is presumed to represent the primary migratory pathway (National Marine Fisheries Service, 2008). NMFS has not defined critical habitat for North Atlantic right whale migration due to the lack of information on migratory routes and data needed to identify essential physical and biological features (Federal Register 81 [17]: 4838-4874). Section 5.4.2.1.5 (North Atlantic Right Whales) presents a discussion of the northern portion of the North Atlantic right whale migration area.

Recent passive acoustic monitoring studies have detected the presence of North Atlantic right whales along the mid-Atlantic coast throughout the year (Hodge et al., 2015; Oedekoven et al., 2015; Salisbury et al., 2015; Whitt et al., 2013). North Atlantic right whales were acoustically detected across all seasons along the coastal waters of North Carolina and Georgia in 2009. Seasonal occurrence peaked during fall off Georgia and during winter off North Carolina; however, a secondary peak occurrence was also recorded from June to July off Georgia, a season during which North Atlantic right whales were not previously believed to be in this region (Hodge et al., 2015). North Atlantic right whales were detected every month from June 2012 to June 2013 between the Virginia coast and the continental shelf. Whales were detected more in fall when they are thought to be migrating to the south; however, a high number of calls were also detected in late winter and early spring when whales are thought to be migrating to the northern feeding grounds (Salisbury et al., 2015). Additional monitoring is needed over a longer time span to better understand the seasonal occurrence of North Atlantic right whales in mid-Atlantic waters.

For additional information about North Atlantic right whale habitats and geographic range, see Section 3.7.2.2.2.2 (Habitat and Geographic Range).

5.4.3.2 Mitigation Area Assessment

When developing Phase III mitigation, the Navy analyzed the potential for increasing mitigation areas in the Study Area. Based on its ongoing analysis of the best available science and potential mitigation measures, the Navy determined it can implement additional mitigation measures off the mid-Atlantic and southeastern United States under the Proposed Action to enhance protection of marine mammals (including North Atlantic right whales) to the maximum extent practicable. In addition to evaluating areas for marine mammals, the Navy assessed the potential for developing mitigation areas for explosives within Habitat Areas of Particular Concern for sandbar and sand tiger sharks. The Navy does not plan to conduct training or testing activities involving explosives in sandbar and sand tiger shark Habitat Areas of Particular Concern off the mid-Atlantic and southeastern United States except for one small mission-essential area in the Lower Chesapeake Bay and in the Navy Cherry Point Range Complex; therefore, mitigation for explosives within the areas off New Jersey and Delaware is not warranted. Information about the Habitat Areas of Particular Concern off Virginia and the new mitigation area developed off North Carolina is presented below.

New mitigation developed for Phase III includes: (1) enlarging the Southeast North Atlantic Right Whale Mitigation Area to correlate with the occurrence of North Atlantic right whales to the maximum extent practicable based on readiness requirements, (2) developing a new mitigation area known as the Southeast North Atlantic Right Whale Critical Habitat Special Reporting Area with special reporting requirements for the use of active sonar and in-water explosives, (3) developing new mitigation measures to use Early Warning System North Atlantic right whale sightings data in the Jacksonville Operating Area, and (4) expanding the mitigation requirements for nearshore areas of the Navy Cherry Point Range Complex to include additional types of explosives to the maximum extent practicable. The remaining mitigation measures presented in Table 5.4-3 are continuations from Phase II.

Mitigation areas off the mid-Atlantic and southeastern United States will avoid or reduce impacts on one or more marine mammal species or stocks and their habitat, as summarized below:

- **Southeast North Atlantic Right Whale Mitigation Area.** The Navy has expanded the existing Southeast North Atlantic Right Whale Mitigation Area northward approximately 50 NM along the coast of northern Georgia from the shoreline out to 10–12 NM. The Navy expanded the mitigation area to correlate with the occurrence of North Atlantic right whales to the maximum extent practicable based on readiness requirements. The mitigation area encompasses a portion of the North Atlantic right whale migration and calving areas identified by LaBrecque et al. (2015b) and a portion of the southeast North Atlantic right whale critical habitat. Mitigation to not conduct or to limit the use of active sonar to the maximum extent practicable (depending on the source) and to not conduct in-water detonations and certain activities using explosives and non-explosive practice munitions will help the Navy further avoid or reduce potential impacts on North Atlantic right whales in these key habitat areas seasonally. The Navy will implement special reporting procedures to report the total hours and counts of active sonar and in-water explosives used in the mitigation area in its annual training and testing activity reports submitted to NMFS. The special reporting requirements will aid the Navy and NMFS in continuing to analyze potential impacts of training and testing in the mitigation area. Mitigation for vessel movements includes minimizing north-south transits, implementing speed reductions after vessels observe a North Atlantic right whale, if they are within 5 NM of a sighting reported within the past 12 hours, or when operating in the mitigation area at night or during periods of poor visibility, and continuing to participate in and sponsor the Early Warning System. The Early

Warning System is a comprehensive information exchange network dedicated to reducing the risk of vessel strikes to North Atlantic right whales off the southeast United States from all mariners (i.e., Navy and non-Navy vessels). Navy participants include the Fleet Area Control and Surveillance Facility, Jacksonville; Commander, Naval Submarine Forces, Norfolk, Virginia; and Naval Submarine Support Command. The Navy, U.S. Coast Guard, U.S. Army Corps of Engineers, and NMFS collaboratively sponsor daily aerial surveys from December 1 through March 31 (weather permitting) to observe for North Atlantic right whales from the shoreline out to approximately 30–35 NM offshore. Aerial surveyors relay sightings information to all mariners transiting within the North Atlantic right whale calving habitat (e.g., commercial vessels, recreational boaters, Navy ships).

- **Jacksonville Operating Area.** The Navy has developed new mitigation measures for units conducting training or testing activities in the Jacksonville Operating Area. The mitigation measures to obtain and use Early Warning System North Atlantic right whale sightings data will help vessels and aircraft reduce potential interactions with North Atlantic right whales in portions of the southeast North Atlantic right whale critical habitat and North Atlantic right whale migration and calving areas identified by LaBrecque et al. (2015b).
- **Southeast North Atlantic Right Whale Critical Habitat Special Reporting Area.** Newly developed for Phase III, the Southeast North Atlantic Right Whale Critical Habitat Special Reporting Area covers the entire southeast North Atlantic right whale critical habitat. The Navy will implement special reporting procedures to report the total hours and counts of active sonar and in-water explosives used in the mitigation area (i.e., the southeast North Atlantic right whale critical habitat) in its annual training and testing activity reports submitted to NMFS. The special reporting requirements will aid the Navy and NMFS in continuing to analyze potential impacts of training and testing in this area.
- **Mid-Atlantic Planning Awareness Mitigation Areas.** The Mid-Atlantic Planning Awareness Mitigation Areas extend across large swaths of shelf break and contain underwater canyons associated with high marine mammal diversity (e.g., Norfolk Canyon). The mitigation areas are situated among highly productive environments, such as persistent oceanographic features associated with upwellings and steep bathymetric contours. Continuing the mitigation within the Mid-Atlantic Planning Awareness Mitigation Areas will help the Navy further avoid or reduce potential impacts from active sonar during major training exercises on marine mammals that inhabit, feed in, reproduce in, or migrate through the mid-Atlantic region. For example, during recent passive acoustic monitoring surveys in Norfolk Canyon, researchers detected vocalizations of blue, fin, minke, sei, sperm, beaked, Kogia, and humpback whales, as well as Risso's dolphins and unidentified delphinid species (Hodge et al., 2016). The Mid-Atlantic Planning Awareness Mitigation Areas overlap a portion of the North Atlantic right whale migration habitat. The more southern mitigation area also overlaps much of the Cape Hatteras Special Research Area.
- **Navy Cherry Point Range Complex Nearshore Mitigation Area.** The Navy is continuing an existing mitigation measure to not conduct explosive mine neutralization activities involving Navy divers from March through September within the mitigation area, which is defined as within 3.2 NM of an estuarine inlet and within 1.6 NM of the shoreline in the Navy Cherry Point Range Complex. For Phase III, the Navy is expanding the mitigation requirements in this mitigation area to include additional in-water explosives to the maximum extent practicable. The mitigation will help the Navy avoid or reduce potential impacts on sea turtles near nesting

beaches during the nesting season and on sandbar sharks in Habitat Areas of Particular Concern. The mitigation area also overlaps a portion of the North Atlantic right whale migration area identified by LaBrecque et al. (2015b).

The Navy conducts training and testing activities off the mid-Atlantic and southeastern United States because this region provides valuable access to sea space and airspace conditions analogous to areas where the Navy operates or may need to operate in the future. The waters off the mid-Atlantic and southeastern United States encompass part of the primary water space in the AFTT Study Area where unit-level training, integrated training, and deployment certification exercises occur. The Navy also uses waters off the mid-Atlantic and southeastern United States for testing components of air warfare, mine warfare, surface warfare, anti-submarine warfare, electronic warfare, vessels and vessel signatures, unmanned systems; and other components, such as chemical and biological simulant testing. The Navy conducts pierside sonar testing at Kings Bay, Georgia; Norfolk, Virginia; and Port Canaveral, Florida.

Training and testing schedules are based on national tasking, the number and duration of training cycles identified in the Optimized Fleet Response Plan and other training plans, forecasting of future testing requirements, and emerging requirements. When scheduling activities, the Navy considers the need to minimize sea space and airspace conflicts within the mid-Atlantic and southeast region and throughout the Study Area. For example, the Navy schedules training and testing to minimize conflicts between its own activities and with consideration for public safety (e.g., safe distances from recreational boating activities). Daily fluctuations in training and testing schedules and objectives could mean that, on any given day, vessels may depend on discrete locations in waters off the mid-Atlantic and southeastern United States for discrete purposes.

The Navy selects training areas in this region to allow for the realistic tactical development of the myriad training scenarios that Navy units are required to complete to be mission effective. For example, the topography and bathymetry in this region consists of a wide continental shelf leading to the shelf break, which affords a wide range of opportunities to plan and execute major training exercises to certify forces to deploy. Certain activities, such as deployment certification exercises that involve integration with multiple warfare components, require large areas of the littorals and open ocean for realistic and safe training. The Jacksonville Operating Area and Charleston Operating Area represent critical training sea spaces that are necessary to prepare naval forces for combat. Training in these areas, such as mine countermeasure training, is vital to ensure Navy units are familiar with this region and will be able to operate and defend the U.S. mainland from adversaries. The Navy selects the locations (e.g., pierside in Kings Bay, Georgia) and scenarios for Civilian Port Defense – Homeland Security Anti-Terrorism/Force Protection exercises according to Department of Homeland Security strategic goals and evolving world events. The Navy uses coastal areas along the U.S. East Coast for a limited number of inshore training activities, such as Kings Bay, Georgia; Charleston Harbor, South Carolina; and St. John's River, Florida. The Navy chooses locations for other training activities based on proximity to training ranges (e.g., Jacksonville Range Complex), available airspace (e.g., avoiding airspace conflicts with major airports such as Jacksonville International Airport), unobstructed sea space, aircraft emergency landing fields (e.g., Naval Air Station Jacksonville), and target storage and deployment locations (e.g., Mayport, Florida).

The Navy conducts testing activities in the mid-Atlantic and southeast region because it provides a variety of bathymetric and environmental conditions necessary to ensure functionality and accuracy of systems and platforms in areas analogous to where the military operates. Testing locations are typically located near systems command support facilities, which provide critical safety, platform, and infrastructure support and technical expertise necessary to conduct testing (e.g., proximity to air squadrons). One example of an important bathymetric feature that provides testing realism and access to necessary environmental or oceanographic conditions in this region is Blake Plateau, which starts at the Continental shelf slope and extends eastward. Other pierside, nearshore, and offshore waters provide critical environments for a multitude of testing activities in this region.

The Navy requires flexibility in the timing of its use of active sonar and explosives in order to meet individual training and testing schedules and deployment schedules. Navy vessels, aviation squadrons, and testing programs have a limited amount of time available for training and testing. The Navy must factor in variables such as maintenance and weather (e.g., hurricanes) when scheduling event locations and timing. The Navy can restrict the number of major training exercises within the Mid-Atlantic Planning Awareness Mitigation Areas because it is not tied to a specific range support structure in this area for these events. However, major training exercise locations may have to change during an exercise or during exercise planning based on assessments of unit performance or other conditions, such as weather and mechanical issues. This precludes the ability to completely prohibit major training exercises from occurring in this region. The schedules of other training activities, such as explosive missile exercises, are driven by deployment requirements and national command authority assignments.

The testing community is required to install and test systems on platforms at the locations where those platforms are stationed. Testing associated with new construction ships must occur in locations close to the shipbuilder's facilities in the mid-Atlantic for reasons associated with construction schedule, proximity to testing facilities, and safety. Additionally, the testing community has a need for rapid development to quickly resolve tactical deficiencies. Overall, training and testing schedules can be cyclical and are partially driven by geo-political situations, which precludes the Navy from implementing additional mitigation to reduce or eliminate the use of active sonar or explosives in this region.

The Navy determined that enlarging the Southeast North Atlantic Right Whale Mitigation Area, developing the new mitigation measures for the Jacksonville Operating Area and Southeast North Atlantic Right Whale Critical Habitat Special Reporting Area, and continuing the mitigation within the Mid-Atlantic Planning Awareness Mitigation Areas as described in Table 5.4-3 would be practical to implement under the Proposed Action. This determination was based on an operational assessment of past use of active sonar, explosives, and non-explosive practice munitions; projected future training and testing needs in the region; and consideration of fleet concentration areas in the Study Area. The mitigation areas off the mid-Atlantic and southeastern United States as described in Table 5.4-3 represent the largest areas and highest level of mitigation within each area that is practical for the Navy to implement within this region under the Proposed Action. The Navy received public comments on the Draft EIS/OEIS requesting additional mitigation, such as avoiding the Charleston Bump, expanding mitigation areas to encompass the full extent of the Cape Hatteras Special Research Area, developing new mitigation areas based on predicted animal densities, developing mitigation areas for bottlenose dolphin small and resident populations identified by LaBrecque et al. (2015b), and further expanding the Southeast North Atlantic Right Whale Mitigation Area eastward to mirror the boundary of the expanded critical habitat and northward to encompass all areas of high animal density. The Navy assessed the potential to implement these and other additional mitigation measures and determined that further modifications of training and testing activities off the mid-Atlantic and southeastern United States would have a significant impact on safety, sustainability, and the Navy's ability to meet its mission requirements, as discussed below.

On 27 January 2016, NMFS issued a Final Rule (81 FR 4838) extending the North Atlantic right whale critical habitat northward and eastward from the prior designation. In the 2016 Final Rule, NMFS determined that the essential features for the expanded critical habitat area were water depth, water temperature, and sea surface roughness. Through the critical habitat expansion process, NMFS determined that current and future Navy mitigation areas should be correlated with the occurrence of North Atlantic right whales, and not with the critical habitat boundary or its essential features (due to implications for national security that would result from the Navy being required to expand its mitigation area to mirror the boundaries of the expanded critical habitat). The best available density data for the Study Area shows that the Navy's Southeast North Atlantic Right Whale Mitigation Area encompasses the areas of highest density in the region (Roberts et al., 2016; U.S. Department of the Navy, 2017b). Although North Atlantic right whales have been sighted on rare occasions east of the mitigation area, these animals were located outside of the higher use habitats that represent the primary occurrence of the population. Overall, most North Atlantic right whale sightings made during Navy and NMFS surveys have occurred in or very near the Southeast North Atlantic Right Whale Mitigation Area, which further indicates that the mitigation area may have the highest seasonal abundance of North Atlantic right whales in waters off the mid-Atlantic and southeastern United States.

The Navy will implement mitigation within the Southeast North Atlantic Right Whale Mitigation Area to minimize the use of active sonar to the maximum extent practicable during three active sonar activities seasonally: helicopter dipping, object detection exercises, and navigation training. Helicopter dipping activities, such as Kilo Dip (a functional check activity) need to occur close to an air station in the event of a system failure if all systems are not functioning properly. Extending these activities farther offshore would significantly increase safety risks for Navy personnel and equipment, and the public. It would be impractical to restrict the number of navigation training and object detection exercises due to implications for the safety of the ship and the personnel on board. These exercises are required to ensure ships can navigate safely and operate safely in a mine threat environment that is extremely dangerous and life-threatening. Additional restrictions (e.g., seasonal limitations) would preclude units from conducting the necessary training to safely operate in military missions and combat operations.

Further expansions of the mitigation areas in this region would require the Navy to relocate its training to alternative locations, such as farther offshore. Moving activities farther offshore would reduce a unit's training opportunities during its limited available training timeframes (i.e., increased time spent transiting to more distant training areas results in decreased time available for training). This would also result in training and testing activities being conducted in water conditions that do not accurately reflect the types of environments where military missions and combat operations occur. Increasing transit distances would result in additional fuel consumption and expenditures, which could serve as a limiting factor for Navy surface units whose available underway times are constrained by fuel expenses.

Some activities, such as surface-to-surface and air-to-surface small-, medium-, and large-caliber gunnery activities and missile and rocket activities, must be conducted in proximity to the target storage and deployment location in Mayport, Florida. Targets used for these activities have limitations on how far offshore they can be safely employed and controlled. For example, remote control jet ski targets stored at Naval Station Mayport would not be able to transit beyond the Southeast North Atlantic Right Whale Mitigation Area in challenging seas. Shifting events farther offshore would preclude the Navy from safely employing and controlling the targets necessary to conduct these training and testing activities, which would significantly impact the Navy's ability to effectively complete the events.

Certain nearshore areas serve as critical training and testing locations for the use of explosives in this region. For example, the Navy's explosive ordnance disposal training location off the coast of Virginia is vital due to its existing target setup, ideal bottom structure, and good bottom depth to safely train Navy divers with explosives. Explosive ordnance disposal teams can be required to deploy with 3-weeks' notice, which presents a need to constantly train to maintain readiness for combat operations. Relocating this activity to a location that does not have these features would increase safety risks and diminish the effectiveness of training events. Similarly, implementing seasonal restrictions on the use of explosive ordnance at this location (e.g., within sandbar shark Habitat Areas of Particular Concern off Virginia) would prevent the Navy from meeting its readiness requirements.

The Navy also uses select inshore areas along the U.S. East Coast, such as Kings Bay, Georgia; Charleston Harbor, South Carolina; and St. John's River, Florida for a limited number of training activities. These waters overlap the habitat extent of bottlenose dolphins within the Southern Georgia Estuarine System Population, Charleston Estuarine System Population, and Jacksonville Estuarine System Population (respectively), which were identified by LaBrecque et al. (2015b) as biologically important areas for bottlenose dolphins. It is critical for national security that the Navy's inshore training activities, such as Civilian Port Defense – Homeland Security Anti-Terrorism/Force Protection exercises, occur in these inshore areas as planned to provide training realism and access to the necessary environmental conditions. Because the Navy conducts a limited number of training activities within inshore areas, implementing additional mitigation would not result in an avoidance or reduction of impacts on bottlenose dolphins in these areas.

Expanding the mitigation areas in this region would encroach upon the primary water space where training and testing activities are scheduled to occur. Implementing additional mitigation off the mid-Atlantic and southeastern United States would have a significant impact on the ability for units to meet their individual training and certification requirements (impacting the ability to deploy with the required level of readiness necessary to accomplish their missions), to certify forces to deploy to meet national security tasking (limiting the flexibility of Combatant Commanders and warfighters to project power, engage in multi-national operations, and conduct the full range of naval warfighting capability in support of national security interests), and for program managers and weapons system acquisition programs to meet testing requirements and required acquisition milestones. Based on the Navy's assessment, additional mitigation in this region would increase operational costs (due to extending distance offshore, which would increase fuel consumption, maintenance, and time on station to complete required training and testing activities), increase safety risks (associated with conducting training and testing at extended distances offshore and farther away from critical medical and search and rescue capabilities), and accelerate fatigue-life of aircraft and ships (leading to increased safety risk and higher maintenance costs). Furthermore, additional mitigation would significantly impact training and testing realism due to reduced access to necessary environmental or oceanographic conditions that replicate military mission and combat conditions. This would diminish the ability for Navy Sailors to train and become proficient in using sensors and weapon systems as required during military missions and combat operations.

The iterative and cumulative impact of all potential mitigation measures the Navy assessed, including certain mitigation measures suggested through public comments on the Draft EIS/OEIS, would deny national command authorities the flexibility to respond to national security challenges and effectively accomplish the training necessary for deployment. For example, additional limitations on the use of active sonar and explosives off the mid-Atlantic and southeastern United States would require the Navy to shift its training activities to alternative locations farther offshore, farther north or south along the Eastern seaboard, or to the Gulf of Mexico. This would have significant impacts on safety, sustainability, and the ability to meet mission requirements within limited available timeframes. Likewise, requiring weapons system program managers and research, testing, and development program managers to use alternative areas within limited available timeframes would deny them the necessary flexibility to rapidly field or develop systems to meet testing program requirements and emerging requirements.

In summary, the Navy developed the mitigation areas identified in Table 5.4-3 to provide further protection for marine mammals in areas the best available science suggests are important for foraging, migrating, and reproduction. The mitigation will help the Navy avoid or reduce potential impacts on numerous species, including North Atlantic right whales. Further restrictions in the mid-Atlantic and southeast region on the level, number, or timing (seasonal or time of day) of training or testing activities would be impractical to due implications for safety, sustainability, and mission requirements.

5.4.4 Mitigation Areas in the Gulf of Mexico

As described in Table 5.4-4 and shown in Figure 5.4-6, the Navy will implement mitigation within mitigation areas in the Gulf of Mexico to, in combination with procedural mitigation, effect the least practicable adverse impact on marine mammal species or stocks and their habitat.

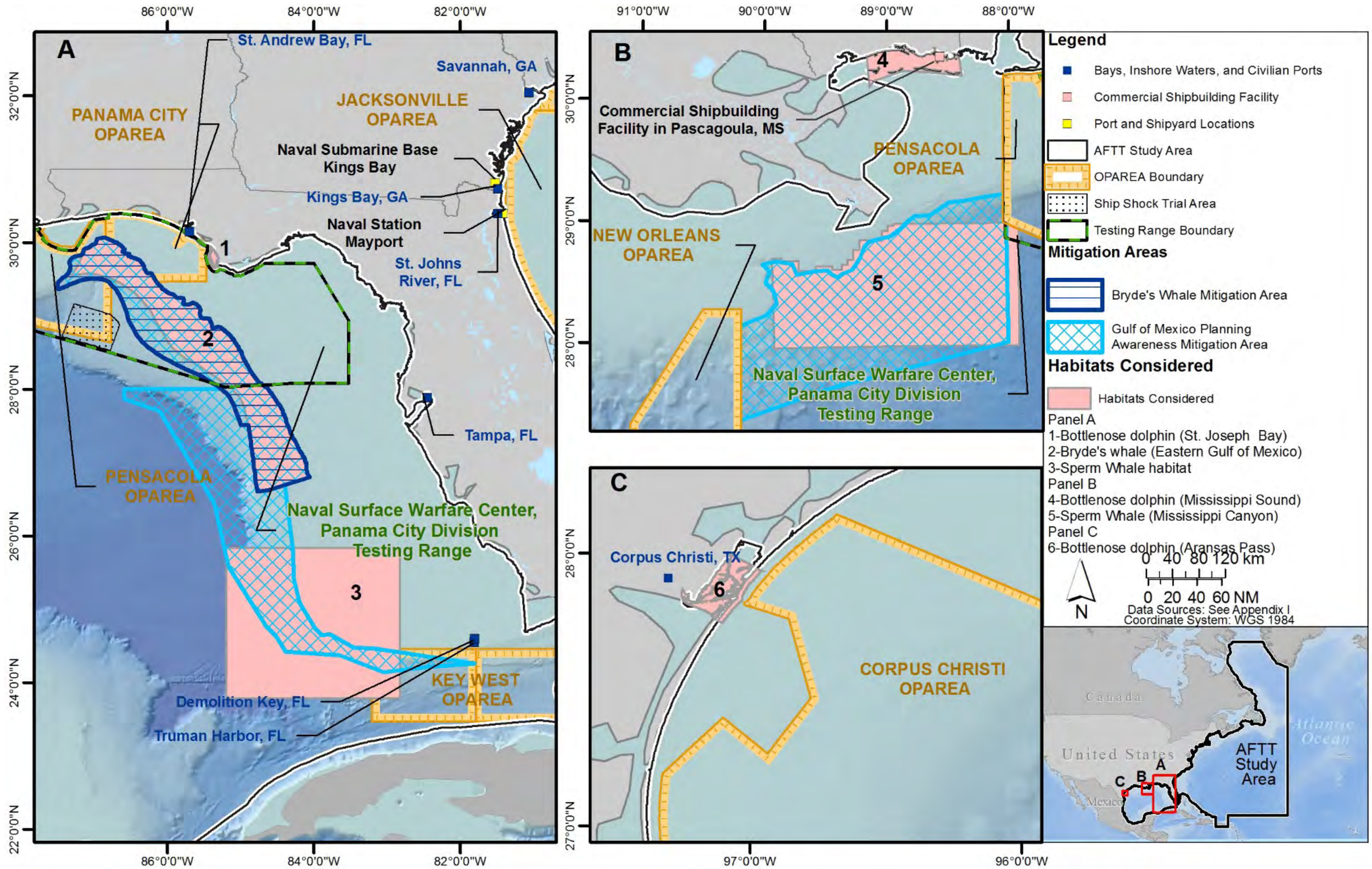
Table 5.4-4: Mitigation Areas in the Gulf of Mexico

Mitigation Area Description
<u>Stressor or Activity</u> • Sonar • Explosives
<u>Resource Protection Focus</u> • Marine mammals
<u>Mitigation Area Requirements (year-round)</u> • **Bryde's Whale Mitigation Area:** – The Navy will report the total hours and counts of active sonar and in-water explosives used in the mitigation area in its annual training and testing activity reports submitted to NMFS. – The Navy will not conduct >200 hours of hull-mounted mid-frequency active sonar per year within the mitigation area. – The Navy will not use explosives (except during mine warfare activities) within the mitigation area. • **Gulf of Mexico Planning Awareness Mitigation Areas:** – The Navy will avoid conducting major training exercises (Composite Training Unit Exercises or Fleet Exercises/Sustainment Exercises) within the mitigation areas to the maximum extent practicable. – The Navy will not conduct any major training exercises within the mitigation areas (all or a portion of the exercise) under Alternative 1. – The Navy will not conduct more than one major training exercise per year within the mitigation areas (all or a portion of the exercise) under Alternative 2. – If the Navy needs to conduct additional major training exercises within the mitigation areas in support of training requirements driven by national security concerns (more than the numbers identified above), it will confer with NMFS to verify that potential impacts are adequately addressed in this Final EIS/OEIS and associated consultation documents.

5.4.4.1 Resource Description

The Navy assessed the Gulf of Mexico region for potential mitigation areas. The assessment included, but was not limited to, the following areas that were identified by LaBrecque et al. (2015a) as biologically important areas (as shown in Figure 5.4-6 and described in the sections below):

- Bottlenose dolphin Aransas Pass small and resident area (year-round)
- Bottlenose dolphin Mississippi Sound small and resident area (year-round)
- Bottlenose dolphin St. Joseph Bay small and resident area (year-round)
- Bryde's whale small and resident population in the Gulf of Mexico (year-round)
- Sperm whale habitat in Mississippi Canyon (year-round)
- Sperm whale habitat west of Key West and the Dry Tortugas (year-round)



Note: AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area

Figure 5.4-6: Mitigation Areas and Habitats Considered in the Gulf of Mexico

5.4.4.1.1 Bottlenose Dolphins

Three areas in the AFTT Study Area were identified by LaBrecque et al. (2015a) as biologically important areas for small and resident populations of bottlenose dolphins in the Gulf of Mexico: (1) Aransas Pass, (2) Mississippi Sound, and (3) St. Joseph Bay. The areas were recognized through various methods, including photo-identification, vessel surveys, satellite tagging, and genetic analyses. The small and resident populations are individual stocks that use the coastal waters as reproductive, migration, and feeding areas (LaBrecque et al., 2015a).

The bottlenose dolphin coastal morphotype is continuously distributed along the U.S. East Coast south of Long Island, New York; around the Florida peninsula; and along the Gulf of Mexico coast. Although the structure of the individually recognized stocks is somewhat uncertain, it appears to be complex. Not every portion of the coast appears to be a significantly important marine mammal habitat; however, scientific evidence suggests that important breeding grounds, migration habitat, and foraging grounds for the individually recognized bottlenose dolphin coastal morphotypes are scattered throughout coastal waters. In the Gulf of Mexico, the Aransas Pass area displays a low level of site fidelity year-round with the most recent study reporting that 35 of 782 individually identified animals were re-sighted over 3 years (1991–1994) (Weller, 1998). In the Gulf of Mexico, the Mississippi Sound area contains animals that display greater site fidelity, with the most recent study reporting that up to 71 individuals display year-round residency and up to 109 animals displayed seasonal fidelity (Mackey, 2010). The St. Joseph Bay area also contains a small portion of St. Andrew Bay, with potential mixing of animals between the two areas (LaBrecque et al., 2015a); however, only St. Joseph Bay is located within the Study Area. Within St. Joseph Bay, a resident population of between 78 and 152 animals was identified (Balmer et al., 2008). Animals from the St. Joseph Bay population are known to move into the mouth of St. Andrew Bay and into nearshore waters (LaBrecque et al., 2015a). Due to ongoing photo-identification studies (including Navy-funded monitoring efforts), the full habitat extent of several of these small and resident populations is subject to change as new information becomes available (LaBrecque et al., 2015a, 2015b).

For additional information about bottlenose dolphin habitats and geographic range, see Section 3.7.2.3.10.2 (Habitat and Geographic Range).

5.4.4.1.2 Bryde's Whales

One area in the AFTT Study Area was identified by LaBrecque et al. (2015a) as a biologically important area for a small and resident population of Bryde's whales in the Gulf of Mexico. The area was identified through vessel and aerial surveys, passive acoustic monitoring, and genetic analyses (LaBrecque et al., 2015a). A recent genetic analysis suggests that the population found in this area is genetically distinct from other Bryde's whales (Rosel & Wilcox, 2014). The Gulf of Mexico subspecies of Bryde's whale was proposed for listing as endangered under the Endangered Species Act in December 2016. The 2016 NMFS status review for this species stated that the biologically important area for Bryde's whale identified by LaBrecque et al. (2015a) would be better defined as out to the 400-m depth contour and to Mobile Bay, Alabama (Rosel et al., 2016).

Bryde's whales are thought to be the most common baleen whale in the Gulf of Mexico (Würsig et al., 2000). They are the only baleen whale known to occur year-round in this region (Jefferson & Schiro, 1997). The population is small (estimated 33 individuals) and resident to the Gulf of Mexico (Rosel et al., 2016). Bryde's whales have been observed exclusively within the northeastern Gulf of Mexico and there is evidence to suggest that this area is more important for this species than any other area within the

Gulf of Mexico. Most Bryde's whale sighting records in the northern Gulf of Mexico are from NMFS abundance surveys (Waring et al., 2016) that were conducted during spring and summer months over several years (Davis & Fargion, 1996; Davis et al., 2000; Hansen et al., 1995; Hansen et al., 1996; Jefferson & Schiro, 1997; Maze-Foley & Mullin, 2006; Mullin & Hoggard, 2000; Mullin & Fulling, 2004). During surveys conducted throughout the oceanic waters of the U.S. Gulf of Mexico, Bryde's whales have been observed between the 100-m and 300-m isobaths in the northeastern Gulf of Mexico. The most recent NMFS Gulf of Mexico abundance survey took place during summer 2009. Three Bryde's whale sightings were recorded seaward of the 100-m depth contour (Waring et al., 2016). More recent surveys in the Gulf of Mexico have been conducted by the Atlantic Marine Assessment Program for Protected Species. During a 2011 survey in the northeastern Gulf of Mexico, three Bryde's whale sightings were reported along the 200-m depth contour (National Marine Fisheries Service, 2011).

Passive acoustic recorders deployed in DeSoto Canyon over 53 days recorded 680 calls attributed to Bryde's whales (Širović et al., 2014). Calls were consistently recorded between March and July, and in October and January. It was noted that there was a lack of calls during November and December. During those times when calls were detected, there was a peak in late June with a relatively high number of calls also recorded in later March, early April, and early January (Širović et al., 2014). In addition to sightings and acoustic data, there are stranding records in the Gulf of Mexico from throughout the year (Würsig et al., 2000). Further studies are required to understand how Bryde's whales use the northeastern Gulf of Mexico for biological life processes, such as reproduction and feeding.

For additional information about Bryde's whale habitats and geographic range, see Section 3.7.2.3.3.2 (Habitat and Geographic Range).

5.4.4.1.3 Sperm Whales

Two areas in the AFTT Study Area have been suggested as potentially important areas for sperm whales in the Gulf of Mexico: Mississippi Canyon and an area west of Dry Tortugas, Florida. Animals within the Northern Gulf of Mexico Stock have been determined to be genetically distinct from other sperm whale stocks (Jochens et al., 2008; Waring et al., 2016).

Aerial and line transect surveys in the northern Gulf of Mexico indicate that numerous marine mammal species, including sperm whales, are widely distributed throughout the northern Gulf of Mexico year-round. Most sperm whale sightings in the Gulf of Mexico have occurred in waters greater than 200 m, over the upper continental slope, and out to deeper waters (more than 2,000 m) (Baumgartner et al., 2001; Davis et al., 2000; Mullin et al., 1994a; Waring et al., 2016). Researchers have identified the Mississippi Canyon and the Mississippi River Delta as an area where sperm whales are sighted consistently throughout the year (Baumgartner et al., 2001; Davis et al., 1998; Maze-Foley & Mullin, 2006; Mullin et al., 1994b; Mullin & Fulling, 2004; Ruiz-Cooley & Engelhaupt, 2010; Weller et al., 2000). The Mississippi Canyon region is noted as being important sperm whale habitat (Davis et al., 1998; Weller et al., 2000). A summer 2009 NMFS vessel survey in the northern Gulf of Mexico reported 39 sperm whale sightings, of which at least 2 were within the Mississippi Canyon area (National Marine Fisheries Service, 2009b). It is thought that the Mississippi River plume and its associated high primary productivity may be the reason that sperm whales aggregate in the area and may be an important feeding habitat during years when biological productivity is high (Jochens et al., 2008; Mullin et al., 2004; Weller et al., 2000). Prey species and their relation to sperm whale distribution patterns have not yet been identified for this area (Jochens et al., 2008). However, researchers have found a correlation between the influx of nutrients from the Mississippi River, water flow patterns, and the distribution and abundance of sperm whales (Biggs et al., 2005; Jochens et al., 2008). Photo-identification, while limited, also suggests that sperm whales in the northern Gulf of Mexico may exhibit differing levels of site fidelity within this region on an annual basis (Jochens et al., 2008; Weller et al., 2000).

Researchers have identified a second potential sperm whale aggregation location as the southeastern region of the northern Gulf of Mexico, an area west of the Dry Tortugas (Maze-Foley & Mullin, 2006; Mullin & Fulling, 2004; Mullin et al., 2004). Surveys conducted by NMFS Southeast Fisheries Science Center and the Bureau of Ocean Energy Management in the southeastern portion of the Gulf of Mexico between June and August of 2012 resulted in observations of 29 sperm whales, all in water deeper than 1,000 m and within the area west of the Dry Tortugas (National Marine Fisheries Service, 2013). This area is thought to have high levels of primary productivity that are influenced by the Loop Current and other dynamic water flow patterns, such as the Tortugas Gyre (Mullin & Fulling, 2004). Sperm whales have been observed in multiple seasons within the area, particularly in locations with steep bathymetry (National Marine Fisheries Service, 2013). Further studies are required to understand how sperm whales use these areas in the Gulf of Mexico for biological life processes, such as reproduction and feeding.

For additional information about sperm whale habitats and geographic range, see Section 3.7.2.2.6.2 (Habitat and Geographic Range).

5.4.4.2 Mitigation Area Assessment

When developing Phase III mitigation, the Navy analyzed the potential for increasing mitigation areas in the Study Area. Based on its ongoing analysis of the best available science and potential mitigation measures, the Navy determined it can implement additional mitigation measures in the Gulf of Mexico under the Proposed Action to enhance protection of marine mammals (including Bryde's whales) to the maximum extent practicable. New mitigation developed for Phase III includes: (1) developing a new mitigation area known as the Bryde's Whale Mitigation Area with special reporting requirements and restrictions on the use of hull-mounted mid-frequency active sonar and in-water explosives, and (2) enlarging the more eastern Gulf of Mexico Planning Awareness Mitigation Area to include the extended area identified by NMFS in its 2016 Bryde's whale status review (Rosel et al., 2016). The remaining mitigation measures presented in Table 5.4-4 are continuations from Phase II.

Mitigation areas in the Gulf of Mexico will avoid or reduce impacts on one or more marine mammal species or stocks and their habitat, as summarized below:

- **Bryde's Whale Mitigation Area.** Newly developed for Phase III, the Bryde's Whale Mitigation Area covers the extent of the Bryde's whale small and resident population area identified by LaBrecque et al. (2015a), including the extended area identified by NMFS in its 2016 Bryde's whale status review (Rosel et al., 2016). Mitigation to limit annual hours of mid-frequency active sonar use and to not use in-water explosives (except during mine warfare activities) will help the Navy avoid or reduce potential impacts on the small and resident population of Bryde's whales. To accomplish the mitigation for explosives, the Navy has adjusted the boundaries of the northern Gulf of Mexico ship shock trial area. The ship shock trial area is being relocated 5 NM from the western boundary of the Bryde's Whale Mitigation Area. This will help the Navy avoid the potential for Bryde's whales to be exposed to explosives during ship shock trials within the mitigation area. The Navy will implement special reporting procedures to report the total hours and counts of active sonar and in-water explosives used in the mitigation area in its annual training and testing activity reports submitted to NMFS. The special reporting requirements will aid the Navy and NMFS in continuing to analyze potential impacts of training and testing in this area.

- **Gulf of Mexico Planning Awareness Mitigation Areas.** The Navy is enlarging the more eastern Gulf of Mexico Planning Awareness Mitigation Area to fully encompass the Bryde's whale small and resident population area identified by LaBrecque et al. (2015a) and the extended area identified by NMFS in its 2016 Bryde's whale status review (Rosel et al., 2016). The Gulf of Mexico Planning Awareness Mitigation Areas overlap most of the Mississippi Canyon sperm whale habitat area and a portion of sperm whale habitat area west of the Dry Tortugas discussed in Section 5.4.4.1.3 (Sperm Whales). They extend across large swaths of shelf break and contain underwater canyons associated with marine mammal abundance (e.g., Mississippi Canyon, DeSoto Canyon). The mitigation areas are situated among highly productive environments, such as persistent oceanographic features associated with upwellings and steep bathymetric contours. Mitigation within the Gulf of Mexico Planning Awareness Mitigation Areas will help the Navy further avoid or reduce potential impacts from active sonar during major training exercises on marine mammals that inhabit, feed in, reproduce in, or migrate through these areas.

The Navy conducts training and testing activities in the Gulf of Mexico because this region provides valuable access to sea space and airspace conditions analogous to areas where the Navy operates or may need to operate in the future. The Gulf of Mexico encompasses part of the primary water space in the AFTT Study Area where certain unit-level training, integrated training, and deployment certification exercises occur, such as mine warfare training. The Gulf of Mexico also supports composite training unit exercises under Alternative 2. The Gulf of Mexico is also important for testing components of air warfare, mine warfare, surface warfare, anti-submarine warfare, electronic warfare, vessels and vessel signatures, unmanned systems; and other areas including submersibles, line charges, and semi-stationary equipment testing. The Navy conducts pierside sonar testing and propulsion testing during sea trials near Pascagoula, Mississippi.

Training and testing schedules are based on national tasking, the number and duration of training cycles identified in the Optimized Fleet Response Plan and various training plans, forecasting of future testing requirements, and emerging requirements. When scheduling activities, the Navy considers the need to minimize sea space and airspace conflicts within the Gulf of Mexico and throughout the entire Study Area. For example, the Navy schedules training and testing to minimize conflicts between its own activities and with consideration for public safety (e.g., safe distances from recreational boating activities). Daily fluctuations in training and testing schedules and objectives could mean that, on any given day, vessels may depend on discrete locations of the Gulf of Mexico for discrete purposes.

The Navy selects training areas in this region to allow for the realistic tactical development of the myriad training scenarios Navy units are required to complete to be mission effective. Certain activities, such as deployment certification exercises that involve integration with multiple warfare components, require large areas of the littorals and open ocean for realistic and safe training. The Navy chooses training locations based on proximity to training ranges (e.g., Pensacola Operating Area), available airspace (e.g., avoiding airspace conflicts with major airports, such as Key West International Airport), unobstructed sea space (e.g., throughout the New Orleans Operating Area), and aircraft emergency landing fields (e.g., Naval Air Station Pensacola). The Navy selects the locations (e.g., pierside in Corpus Christi, Texas) and scenarios for Civilian Port Defense – Homeland Security Anti-Terrorism/Force Protection exercises according to Department of Homeland Security strategic goals and evolving world events.

The Navy conducts testing activities in the Gulf of Mexico because it provides a variety of bathymetric and environmental conditions necessary to ensure functionality and accuracy of systems and platforms in areas analogous to where the military operates. Testing locations are typically located near systems command support facilities, which provide critical safety, platform, and infrastructure support and technical expertise necessary to conduct testing (e.g., proximity to air squadrons). Naval Surface Warfare Center, Panama City Division Testing Range provides critical capabilities for meeting littoral and expeditionary maneuver warfare requirements by providing research, development, test, and evaluation and in-service engineering for expeditionary maneuver warfare, operations in extreme environments, mine warfare, maritime operations, and coastal operations. The Navy has designated the Key West Operating Area as a back-up location for sonobuoy lot acceptance testing when the primary area of San Clemente Island, California is not available. The Key West Operating Area is particularly valuable due to the favorable weather conditions (e.g., low sea state) that are typical of the area.

The Navy requires flexibility in the timing of its use of active sonar and explosives in order to meet individual training and testing schedules and deployment schedules. Navy vessels, aviation squadrons, and testing programs have a limited amount of time available for training and testing. The Navy must factor in variables such as maintenance and weather (e.g., hurricanes) when scheduling event locations and timing. The Navy can restrict the number of major training exercises within the Gulf of Mexico Planning Awareness Mitigation Areas because it is not tied to a specific range support structure in this area for these events. However, major training exercise locations may have to change during an exercise or during exercise planning based on assessments of unit performance or other conditions, such as weather and mechanical issues. This precludes the ability to completely prohibit major training exercises from occurring in the entire region.

The testing community is required to install and test systems on platforms at the locations where those platforms are stationed. Testing associated with new construction ships must occur in locations close to the shipbuilder's facilities in the Gulf of Mexico for reasons associated with construction schedule, proximity to testing facilities, and safety. Additionally, the testing community has a need for rapid development to quickly resolve tactical deficiencies. Overall, training and testing schedules can be cyclical and are partially driven by geo-political situations, which precludes the Navy from implementing additional mitigation to reduce or eliminate the use of active sonar or explosives in the Gulf of Mexico.

The Navy determined that enlarging the more eastern Gulf of Mexico Planning Awareness Mitigation Area, developing the new Bryde's Whale Mitigation Area, and continuing the other mitigation measures as described in Table 5.4-4 would be practical to implement under the Proposed Action. This determination was based on an operational assessment of past use of active sonar, explosives, and non-explosive practice munitions; projected future training and testing needs in the region; and consideration of fleet concentration areas in the Study Area. The mitigation areas in the Gulf of Mexico as described in Table 5.4-4 represent the largest areas and highest level of mitigation within each area that is practical for the Navy to implement within this region under the Proposed Action. Further modifications of training and testing activities in the Gulf of Mexico, such as developing mitigation areas for bottlenose dolphin small and resident population areas identified by LaBrecque et al. (2015a) or for dolphin habitat associated with the Deepwater Horizon oil spill, would have a significant impact on safety, sustainability, and the Navy's ability to meet its mission requirements, as discussed below.

Further expansions of the mitigation areas in this region would require the Navy to relocate its activities to alternative locations, such as farther offshore. Moving activities farther offshore would reduce a unit's training opportunities during its limited available training timeframes (i.e., increased time spent transiting to more distant training areas results in decreased time available for training). This would also result in training and testing activities being conducted in water conditions that do not accurately reflect the types of environments where military missions and combat operations occur. Increasing transit distances would result in additional fuel consumption and expenditures, which could serve as a limiting factor for Navy surface units whose available underway times are constrained by fuel expenses.

The Navy uses select inshore areas in the Gulf of Mexico for a limited number of training and testing activities. These waters overlap the habitat extent of bottlenose dolphins within the Aransas Pass, Mississippi Sound, and St. Joseph Bay small and resident populations identified by LaBrecque et al. (2015a). It is critical for national security that the Navy's inshore activities, such as Civilian Port Defense – Homeland Security Anti-Terrorism/Force Protection exercises, occur in these inshore areas as planned to provide realism and access to the necessary environmental conditions. Because the Navy conducts a limited number of activities within inshore areas, implementing additional mitigation would not result in an avoidance or reduction of impacts on bottlenose dolphins in these areas.

Expanding the mitigation areas in this region would encroach upon the primary water space where training and testing activities are scheduled to occur. Implementing additional mitigation in the Gulf of Mexico would have a significant impact on the ability for units to meet their individual training and certification requirements (impacting the ability to deploy with the required level of readiness necessary to accomplish their missions), to certify forces to deploy to meet national security tasking (limiting the flexibility of Combatant Commanders and warfighters to project power, engage in multi-national operations, and conduct the full range of naval warfighting capability in support of national security interests), and for program managers and weapons system acquisition programs to meet testing requirements and required acquisition milestones. Based on the Navy's assessment, additional mitigation in this region would increase operational costs (due to extending distance offshore, which would increase fuel consumption, maintenance, and time on station to complete required training and testing activities), increase safety risks (associated with conducting training and testing at extended distances offshore and farther away from critical medical and search and rescue capabilities), and accelerate fatigue-life of aircraft and ships (leading to increased safety risk and higher maintenance costs). Furthermore, additional mitigation would significantly impact training and testing realism due to reduced access to necessary environmental or oceanographic conditions that replicate military mission and combat conditions. This would diminish the ability for Navy Sailors to train and become proficient in using sensors and weapon systems as required during military missions and combat operations.

The iterative and cumulative impact of all potential mitigation measures the Navy assessed, including certain mitigation measures suggested through public comments on the Draft EIS/OEIS, would deny national command authorities the flexibility to respond to national security challenges and effectively accomplish the training necessary for deployment. For example, additional limitations on the use of active sonar and explosives in the Gulf of Mexico would require the Navy to shift its training activities to alternative locations further offshore or to areas along the Eastern seaboard. This would have significant impacts on safety, sustainability, and the ability to meet mission requirements within limited available timeframes. Likewise, requiring weapons system program managers and research, testing, and development program managers to use alternative areas within limited available timeframes would deny them the necessary flexibility to rapidly field or develop systems to meet testing program requirements and emerging requirements.

In summary, the Navy developed the mitigation areas identified in Table 5.4-4 to provide further protection for marine mammals in areas the best available science suggests are important to small and resident populations of Bryde's whales and sperm whales. The mitigation will help the Navy avoid or reduce potential impacts from active sonar or explosives on these species. Further restrictions in the

Gulf of Mexico on the level, number, or timing (seasonal or time of day) of training or testing activities would be impractical to due implications for safety, sustainability, and mission requirements.

5.5 Measures Considered but Eliminated

As described in Section 5.2 (Mitigation Development Process), the Navy conducted a detailed review and assessment of each potential mitigation measure individually and then all potential mitigation measures collectively to determine if, as a whole, the mitigation will be effective at avoiding or reducing impacts and practical to implement. The assessment included consideration of mitigation recommendations received during scoping, through public comments, and during consultations for Phase III and past environmental compliance documents applicable to the Study Area. The operational community determined that implementing mitigation beyond what is detailed in Section 5.3 (Procedural Mitigation to be Implemented) and Section 5.4 (Mitigation Areas to be Implemented) would be incompatible with the practicality assessment criteria for safety, sustainability, and mission requirements. Information about why implementing additional mitigation measures for active sonar, explosives, active and passive acoustic monitoring devices, thermal detection systems, third-party observers, foreign navy mitigation, reporting requirements, and permission schemes would be impractical is provided in the sections below. Information about why implementing additional geographic mitigation would be impractical is provided in Section 5.4 (Mitigation Areas to be Implemented).

When analyzing all potential mitigation measures collectively, the operational community determined that adopting the additional mitigation measures beyond what is included in this Final EIS/OEIS would essentially result in the Navy losing access to the significant majority of its required sea space and airspace. Additional measures would restrict or prohibit Navy training and testing along the U.S. East coast and throughout the Gulf of Mexico except in very narrow circumstances. For example, blanket limitations or restrictions on the level, number, or timing (seasonal or time of day) of training and testing activities within discrete or broad-scale areas of water (e.g., embayments and large swaths of the littorals and open ocean), or other areas vital to mission requirements would prevent the Navy from accessing its ranges, operating areas, facilities, or range support structures necessary to meet the purpose and need of the Proposed Action. As described in Section 5.2.3 (Practicality of Implementation), the Navy requires extensive sea space so that individual training and testing activities can occur at sufficient distances so they do not interfere with one another, and so that Navy units can train to communicate and operate in a coordinated fashion over tens or hundreds of square miles, as required during military missions and combat operations. The Navy also needs to maintain access to sea space with the unique, challenging, and diverse environmental and oceanographic features (e.g., bathymetry, topography, surface fronts, and variations in sea surface temperature) analogous to military mission and combat conditions to achieve the highest skill proficiency and most accurate testing results possible.

Threats to national security are constantly evolving. The Navy requires the ability to adapt training and testing to meet these emerging threats. Restricting access to broad-scale areas of water would impact the ability for Navy training and testing to evolve as the threat evolves. Eliminating opportunities for the Navy to train and test in a myriad of at-sea conditions would put U.S. forces at a tactical disadvantage during military missions and combat operations. This would also present a risk to national security if adversaries were to be alerted to the environmental conditions within which the U.S. Navy is prohibited from training and testing. Restricting large areas of ocean or other smaller areas at sea that are critical to Navy training and testing would make training and concealment much more difficult and would adversely impact the Navy's ability to perform its statutory mission.

5.5.1 Active Sonar

When assessing and developing mitigation, the Navy considered reducing active sonar training and testing hours, modifying active sonar sound sources, implementing time-of-day restrictions and restrictions during surface ducting conditions, replacing active sonar training and testing with synthetic activities (e.g., computer simulated training), and implementing active sonar ramp-up procedures. As discussed in Chapter 2 (Description of Proposed Action and Alternatives), Section 5.2.3 (Practicality of Implementation), and Appendix A (Navy Activity Descriptions), training and testing activities are planned and scheduled based on numerous factors and data inputs, such as compliance with the Optimized Fleet Response Plan. Information on why training and testing with active sonar is essential to national security is presented in Section 5.3.2.1 (Active Sonar). The Navy uses active sonar during military readiness activities only when it is essential to training missions or testing program requirements since active sonar has the potential to alert opposing forces to the operating platform's presence. Passive sonar and other available sensors are used in association with active sonar to the maximum extent practicable.

The Navy currently uses, and will continue to use, computer simulation to augment training and testing whenever possible. As discussed in Section 1.4.1 (Why the Navy Trains), simulators and synthetic training are critical elements that provide early skill repetition and enhance teamwork; however, they cannot duplicate the complexity faced by Sailors during military missions and combat operations for the types of active sonar used under the Proposed Action (e.g., hull-mounted mid-frequency active sonar). Just as a pilot would not be ready to fly solo after simulator training, a Navy Commander cannot allow military personnel to engage in military missions and combat operations based merely on simulator training. Similarly, in testing a system that is being developed, simulation can be used during the initial stages of development, but ultimately the system must be tested under conditions analogous to those faced during military missions and combat operations. Systems that have undergone maintenance need to be tested, and not simulated, to ensure that the system is operating correctly.

Sonar operators must train to effectively handle bottom bounce and sound passing through changing currents, eddies, and across changes in ocean temperature, pressure, salinity, depth, and in surface ducting conditions. Sonar systems must be tested in these conditions to ensure functionality and accuracy in military mission and combat conditions. The Navy tests its active sonar systems in areas analogous to where the Navy trains and operates. This includes a nighttime testing requirement for some active sonar systems, and a requirement to test in a variety of locations and environmental conditions depending on the testing program objectives. Training and testing in good visibility (e.g., daylight, favorable weather conditions) and low visibility (e.g., nighttime, inclement weather conditions) is vital because environmental differences between day and night and varying weather conditions affect sound propagation and the detection capabilities of sonar. Temperature layers that move up and down in the water column and ambient noise levels can vary significantly between night and day. This affects sound propagation and how sonar systems function and are operated.

Submarines may hide in the higher ambient noise levels of shallow coastal waters and surface ducts. Surface ducting occurs when water conditions, such as temperature layers and lack of wave action, result in little sound energy penetrating beyond a narrow layer near the surface of the water. Avoiding surface ducting conditions would be impractical because ocean conditions contributing to surface ducting change frequently and surface ducts can be of varying duration. Surface ducting can also lack uniformity and may or may not extend over a large geographic area, making it difficult to determine where to reduce power and for what periods. Submarines have long been known to take advantage of the phenomena associated with surface ducting to avoid being detected by sonar. When surface ducting occurs, active sonar becomes more useful near the surface but less useful at greater depths. As noted by the U.S. Supreme Court in *Winter v. Natural Resources Defense Council, Inc.*, 555 U.S. 7 (2008), because surface ducting conditions occur relatively rarely and are unpredictable, it is especially important for the Navy to be able to train under these conditions when they occur. Training with active sonar in these conditions is a critical component of military readiness because sonar operators need to learn how sonar transmissions are altered due to surface ducting, how submarines may take advantage of them, and how to operate sonar effectively under these conditions. Reducing power or shutting down active sonar based on environmental conditions as a mitigation would affect a Commander's ability to develop the tactical picture. It would also prevent sonar operators from training in conditions analogous to those faced during military missions and combat operations, such as during periods of low visibility.

Active sonar signals are designed explicitly to provide optimum performance at detecting underwater objects (e.g., submarines) in a variety of acoustic environments. The Navy assessed the potential for implementing active sonar signal modification as mitigation. At this time, the science on the differences in potential impacts of up or down sweeps of the sonar signal (e.g., different behavioral reactions) is extremely limited and requires further development. If future studies indicate that modifying active sonar signals (i.e., up or down sweeps) could be an effective mitigation approach, then the Navy will investigate if and how the mitigation would affect the sonar's performance.

Active sonar equipment power levels are set consistent with mission requirements. Active sonar ramp-up procedures are used during seismic surveys and some foreign navy sonar activities. Ramping up involves slowly increasing sound levels over a certain length of time until the optimal source level is reached. The intent of ramping up a sound source is to alert marine mammals with a low sound level to deter them from the area and avoid higher levels of sound exposure. The best available science does not suggest that ramp-up would be an effective mitigation tool for U.S. Navy active sonar training and testing activities under the Proposed Action. Wensveen et al. (2017) found that active sonar ramp-up was not an effective method for reducing impacts on humpback whales because most whales did not display strong behavioral avoidance to the sonar signals. The study suggested that sonar ramp-up could potentially be more effective for other more behaviorally responsive species but would likely also depend on the context of exposure. For example, ramp-up would be less effective if animals have a strong motivation not to move away from their current location, such as when foraging. Dunlop et al. (2016) and von Benda-Beckmann et al. (2014) found that implementing ramp-up as mitigation may be effective for some activities in some situations. Additionally, von Benda-Beckmann et al. (2014) found that the main factors limiting ramp-up effectiveness for a typical anti-submarine warfare activity are a high source level, a moving sonar source, and long silences between consecutive sonar transmissions. Based on the source levels, vessel speeds, and sonar transmission intervals that will be used during typical active sonar activities under the Proposed Action, the Navy has determined that ramp-up would be an ineffective mitigation measure for the active sonar activities analyzed in this document.

Implementing active sonar ramp-up procedures during training or testing under the Proposed Action would not be representative of military mission and combat conditions and would significantly impact training and testing realism. For example, during an anti-submarine warfare exercise using active sonar, ramp-ups have the potential to alert opponents (e.g., target submarines) to the transmitting vessel's presence. This would defeat the purpose of the training by allowing the target submarine to detect the searching unit and take evasive measures, thereby denying the sonar operator the opportunity to learn how to locate the submarine. Similarly, testing program requirements determine test parameters to accurately determine whether a system is meeting its operational and performance requirements;

therefore, implementing ramp-up during testing activities would impede the Navy's ability to collect essential data for evaluation of a system's capabilities.

Reducing realism in training impedes the ability for Navy Sailors to train and become proficient in using active sonar, erodes capabilities, and reduces perishable skills. These impacts would result in a significant risk to personnel safety during military missions and combat operations and would prevent units from meeting their individual training and certification requirements. Therefore, implementing additional mitigation that would reduce training realism would ultimately prevent units from deploying with the required level of readiness necessary to accomplish their missions and impede the Navy's ability to certify forces to deploy to meet national security tasking. Reducing realism in testing would impact the ability of researchers, program managers, and weapons system acquisition programs to conduct accurate acoustic research and effectively test systems and platforms (and components of these systems and platforms) before full-scale production or delivery to the fleet. These tests are required to ensure functionality and accuracy in military mission and combat conditions per required acquisition milestones or on an as-needed basis to meet operational requirements.

5.5.2 Explosives

When assessing and developing mitigation, the Navy considered reducing the number and size of explosives and limiting the locations and time of day of explosive training and testing in the Study Area. As discussed in Chapter 2 (Description of Proposed Action and Alternatives), Section 5.2.3 (Practicality of Implementation), and Appendix A (Navy Activity Descriptions), the locations and timing of the training and testing activities that use explosives vary throughout the Study Area based on range scheduling, mission requirements, testing program requirements, and standard operating procedures for safety and mission success. The Navy's suite of mitigation includes extensive mitigation areas for explosives, including avoiding seafloor resource areas throughout the Study Area and important marine mammal habitats in the northeast, mid-Atlantic, southeast, and Gulf of Mexico. The Navy determined that, beyond what is described in Section 5.4 (Mitigation Areas to be Implemented), it would be impractical to develop additional mitigation areas to limit the locations of explosive training and testing activities.

Activities that involve explosive ordnance are inherently different from those that involve non-explosive practice munitions. For example, critical components of an explosive Bombing Exercise Air-to-Surface include the assembly, loading, delivery, and assessment of the explosive bomb. The explosive bombing training exercise starts with ground personnel, who must practice the building and loading of explosive munitions. Training includes the safe handling of explosive material, configuring munitions to precise specifications, and the loading of munitions onto aircraft. Aircrew must then identify a target and safely deliver fused munitions, discern if the bomb was assembled correctly, and determine bomb damage assessments based on how and where the explosive detonated. An air-to-surface bombing exercise using non-explosive practice munitions can train aircrews on valuable skills to locate and accurately deliver munitions on a target; however, it cannot effectively replicate the critical components of an explosive activity in terms of assembly, loading, delivery, and assessment of an explosive bomb. Reducing the number and size of explosives or diminishing activity realism by implementing time of day or geographic restrictions for additional explosive training exercises would impede the ability for Navy Sailors to train and become proficient in using explosive weapon systems (which would result in a significant risk to personnel safety during military missions and combat operations), and would ultimately prevent units from meeting their individual training and certification requirements (which would prevent them from deploying with the required level of readiness necessary to accomplish their missions) and impede the Navy's ability to certify forces to deploy to meet national security tasking.

Similar to training, the Navy is required to test its explosives to quantify the compatibility of weapons with the platform from which they will be launched or released in military missions and combat operations. Such testing requires the use of the actual explosive ordnance that will be used during training exercises, military missions, and combat operations. Reducing the number and size of explosives or diminishing activity realism by implementing time of day or geographic restrictions for additional explosive testing events would impact the ability of researchers, program managers, and weapons system acquisition programs to effectively test systems and platforms (and components of these systems and platforms). Such testing must be conducted before full-scale production or delivery to the fleet to ensure functionality and accuracy in military mission and combat conditions per required acquisition milestones or on an as-needed basis to meet operational requirements.

5.5.3 Active and Passive Acoustic Monitoring Devices

When assessing and developing mitigation, the Navy considered using active and passive acoustic monitoring devices as procedural mitigation. During Surveillance Towed Array Sensor System low-frequency active sonar (which is not part of the Proposed Action), the Navy uses a specially-designed adjunct high-frequency marine mammal monitoring active sonar known as “HF/M3” to mitigate potential impacts. HF/M3 can only be towed at slow speeds and operates like a fish finder used by commercial and recreational fishermen. Installing the HF/M3 adjunct system on the tactical sonar ships used under the Proposed Action would have implications for safety and mission requirements due to impacts on speed and maneuverability. Furthermore, installing the system would significantly increase costs associated with designing, building, installing, maintaining, and manning the equipment. The Navy will not install the HF/M3 system or other adjunct marine mammal monitoring devices as mitigation under the Proposed Action. However, Navy assets with passive acoustic monitoring capabilities that are already participating in an activity will continue to monitor for marine mammals, as described in Section 5.2.1 (Procedural Mitigation Development) and Section 5.3 (Procedural Mitigation to be Implemented). Significant manpower and logistical constraints make constructing and maintaining additional passive acoustic monitoring systems for each training and testing activity under the Proposed Action impractical. Diverting platforms with passive acoustic monitoring capabilities to monitor training and testing events would impact their ability to meet their mission requirements and would reduce the service life of those systems.

The Navy is continuing to improve its capabilities to use range instrumentation to aid in the passive acoustic detection of marine mammals. For example, at the Southern California Offshore Range, the Pacific Missile Range Facility off Kauai, Hawaii, and the Atlantic Undersea Test and Evaluation Center in the Bahamas, the Navy can monitor instrumented ranges in real-time or through data recorded by hydrophones. The Navy has sponsored numerous studies that have produced meaningful results on marine mammal occurrence, distribution, and behavior on these ranges through the U.S. Navy Marine Species Monitoring Program. For information on the U.S. Navy Marine Species Monitoring Program, see Section 3.0.1.1 (Marine Species Monitoring and Research Programs) and Section 5.1.2.2.1 (Marine Species Research and Monitoring Programs).

The Navy’s instrumented ranges are helping to facilitate a better understanding of the species that are present in those areas. However, instrumented ranges do not have the capabilities to be used effectively for mitigation. To develop an estimated position for an individual marine mammal, the animal’s vocalizations must be detected on at least three hydrophones. The vocalizations must be loud enough to provide the required signal to noise ratio on those hydrophones. The hydrophones must have the required bandwidth and dynamic range to capture that signal. Detection capabilities are generally degraded under noisy conditions that affect signal to noise ratio, such as high sea state. The ability to detect and develop an estimated position for marine mammals on the Navy's instrumented ranges depends of numerous factors, such as behavioral state, species, location relative to the hydrophones, and location on the range. For example, only vocalizing animals can be detected, and species vocalize at varying rates, call types, and source levels. The Navy's hydrophones cannot track the real-time locations of individual animals with dispersed and directional vocalizations with the level of precision needed for effective mitigation. Even marine mammals that have been vocalizing for extended periods of time have been known to stop vocalizing for hours at a time, which would prevent the Navy from obtaining or maintaining an accurate estimate of that animal's location. In addition, the Navy does not currently have the capability to perform data processing for large baleen whales in real-time. Determining if an animal is located within a mitigation zone within the timeframes required for mitigation would be prohibited by the amount of time it takes to process the data.

If a vocalizing animal is detected on only one or two hydrophones, estimating its location is not possible, and the location of the animal would be assigned generally within the detection radius around each hydrophone. The detection radius of a hydrophone is typically much larger than the mitigation zone for the activities conducted on instrumented ranges. The Navy does not have a way to verify if that vocalizing animal is located within the mitigation zone or at a location down range. Mitigating for passive acoustic detections based on unknown animal locations would essentially increase the mitigation zone sizes for each activity to that of the hydrophone detection radius. Increasing the mitigation zone sizes beyond what is described for each activity is impractical for the reasons described throughout Section 5.3 (Procedural Mitigation to be Implemented).

In summary, although the Navy is continuing to improve its capabilities to use range instrumentation to aid in the passive acoustic detection of marine mammals, at this time it would not be effective or practical for the Navy to monitor instrumented ranges for real-time mitigation or to construct additional instrumented ranges as a tool to aid in the implementation of mitigation.

5.5.4 Thermal Detection Systems

Thermal detection technology is designed to allow observers to detect the difference in temperature between a surfaced marine mammal (i.e., the body or blow of a whale) and the environment (i.e., the water and air). Although thermal detection may be reliable in some applications and environments, current technologies are limited by their: (1) reduced performance in certain environmental conditions, (2) inability to detect certain animal characteristics and behaviors, (3) low sensor resolution and narrow fields of view, and (4) high cost and low lifecycle (Boebel, 2017; Zitterbart et al., 2013).

Thermal detection systems can be effective at detecting some types of marine mammals in a limited range of marine environmental conditions. Current thermal detection systems have proven more effective at detecting large whale blows than the bodies of small animals, particularly at a distance (Zitterbart et al., 2013). The effectiveness of current technologies has not been demonstrated for small marine mammals. Thermal detection systems exhibit varying degrees of false positive detections (i.e., incorrect notifications) due in part to their low sensor resolution and reduced performance in certain environmental conditions. False positive detections may incorrectly identify other features (e.g., birds, waves, boats) as marine mammals. In one study, Zitterbart et al. (2013) reported a false positive rate approaching one incorrect notification per 4 min. of observation.

Thermal detection systems are generally thought to be most effective in cold environments, which have a large temperature differential between an animal's temperature and the environment. Two studies that examined the effectiveness of thermal detection systems for marine mammal observations are Zitterbart et al. (2013), which tested a thermal detection system and automatic algorithm in polar waters between 34–50 degrees Fahrenheit, and a Navy-funded study in subtropical and tropical waters. Zitterbart et al. (2013) found that current technologies have limitations regarding temperature and survey conditions (e.g., rain, fog, sea state, glare, ambient brightness), for which further effectiveness studies are required. The Office of Naval Research Marine Mammals and Biology program funded a project (2013-2018) to test the thermal limits of infrared-based automatic whale detection technology. This project is focused on capturing whale spouts at two different locations featuring subtropical and tropical water temperatures, optimizing detector/classifier performance on the collected data, and testing system performance by comparing system detections with concurrent visual observations.

The Navy has also been investigating the use of thermal detection systems with automated marine mammal detection algorithms for future mitigation during training and testing, including on autonomous platforms. For example, the Defense Advanced Research Projects Agency funded six initial studies to test and evaluate infrared-based thermal detection technologies and algorithms to automatically detect marine mammals on an unmanned surface vehicle. Based on the outcome of these initial studies, follow-on efforts and testing are planned for 2018-2019.

Thermal detection systems are currently used by some specialized U.S. Air Force aircraft for marine mammal mitigation. These systems are specifically designed for and integrated into Air Force aircraft and cannot be added to Navy aircraft. Only certain Navy aircraft have specialized infrared capabilities, and these capabilities are only for fine-scale targeting within a narrow field of view. The only thermal imagery sensors aboard Navy surface ships are associated with specific weapons systems, and these sensors are not available on all vessels. These sensors are typically used only in select training events, have a limited lifespan before requiring expensive replacement, and are not optimized for marine mammal observations within the Navy's mitigation zones. For example, as described in Section 5.3.3.3 (Explosive Medium-Caliber and Large-Caliber Projectiles), Lookouts are required to observe a 1,000-yd. mitigation zone around the intended impact location during explosive large-caliber gunnery activities. In addition to observing for marine mammals, one of the activity's mission-essential requirements is for event participants, including Lookouts, to maintain focus on the mitigation zone to ensure the safety of Navy personnel and equipment and the public. Lookouts would not be able to observe the 1,000-yd. mitigation zone using the Navy's thermal imagery sensors due to their narrow fields of view and technological design specific to fine-scale targeting. Such observations would be ineffective for marine mammals and would prevent Lookouts from effectively maintaining focus on the activity area and implementing mission-essential safety protocols.

The effectiveness of even the most advanced commercially available thermal detection systems with technological designs specific to marine mammal observations is highly dependent on environmental conditions, animal characteristics, and animal behaviors (Zitterbart et al., 2013). Considering the range of environmental conditions and diversity of marine mammal species found throughout the Study Area, the use of thermal detection systems would be less effective than the traditional techniques currently employed by the Navy, such as naked-eye scanning, hand-held binoculars, and high-powered binoculars mounted on a ship deck. Furthermore, high false positive rates of thermal detection systems could result in the Navy implementing mitigation for features incorrectly identified as marine mammals. Increasing the instances of mitigation implementation based on incorrectly-identified features would have significant impacts on the ability for training and testing activities to accomplish their intended objectives, without providing any mitigation benefit to the species. In addition, thermal detection systems are designed to detect marine mammals and do not have the capability to detect other resources for which the Navy is required to implement mitigation. Requiring Lookouts to use thermal detection systems would prevent them from detecting and mitigating for sea turtles and other biological resources (e.g., floating vegetation, jellyfish aggregations, large schools of fish).

As discussed in Section 5.3 (Procedural Mitigation to be Implemented), the Navy's procedural mitigation measures include the maximum number of Lookouts the Navy can assign to each activity based on available manpower and resources. It would be impractical to add personnel to serve as additional Lookouts for the sole purpose of thermal detection system use. For example, the Navy does not have available manpower to add Lookouts to use thermal detection systems in tandem with existing Lookouts who are using traditional observation techniques.

In summary, thermal detection systems have not been sufficiently studied both in terms of their effectiveness within the environmental conditions found in the Study Area and their compatibility with Navy training and testing. The Navy plans to continue researching thermal detection systems to determine their effectiveness and compatibility with Navy applications. If the technology matures to the state where thermal detection is determined to be an effective mitigation tool during training and testing, the Navy will assess the practicality of using the technology during training and testing events and retrofitting its observation platforms with thermal detection devices. The assessment will include an evaluation of the budget and acquisition process (including costs associated with designing, building, installing, maintaining, and manning equipment that is expensive and has a relatively short lifecycle before key system components need replacing); logistical and physical considerations for device installment, repair, and replacement (e.g., conducting engineering studies to ensure there is no electronic or power interference with existing shipboard systems); manpower and resource considerations for training personnel to effectively operate the equipment; and considerations of potential security and classification issues. New system integration on Navy assets can entail up to 5 to 10 years of effort to account for acquisition, engineering studies, and development and execution of systems training. The Navy will provide information to NMFS about the status and findings of Navy-funded thermal detection studies and any associated practicality assessments at the annual adaptive management meetings. Information about the Navy's adaptive management program is included in Section 5.1.2.2.1.1 (Adaptive Management).

5.5.5 Third-Party Observers

When assessing and developing mitigation, the Navy considered increasing the use of third-party observers during training and testing to aid in the implementation of procedural mitigation. The use of third-party observers to conduct pre- or post-activity biological resource observations would be an ineffective mitigation because marine mammals would likely move into or out of the activity area, and mitigation must be implemented at the time the activity is taking place. The Navy will use third-party observers in combination with Lookouts for ship shock trials primarily because of the requirement to conduct marine species monitoring for multiple days after the event, which would detract Navy personnel from essential tasks related to mission objectives.

There are significant manpower and logistical constraints that make using third-party observers for every training and testing activity under the Proposed Action impractical. Training and testing activities often occur simultaneously and in various regions throughout the Study Area, some of which last for days or weeks at a time. Having third-party observers embark on Navy vessels or aircraft would result in safety and security clearance issues. Training and testing event planning includes careful consideration of capacity limitations when placing personnel on participating aircraft and vessels. The Navy is unable to add third-party observers on a ship or substitute a Navy Lookout with a third-party observer without causing a berthing shortage or exceedance of other space limitations, or impacting the ability for Lookouts to complete their other mission-essential duties. The use of third-party observers also presents national security concerns due to the requirement to provide advance notification of specific times and locations of Navy platform movements and activities (e.g., vessels using active sonar).

Reliance on the availability of third-party personnel for mitigation would be impractical because training and testing activity timetables oftentimes cannot be precisely fixed and are instead based on the free-flow development of tactical situations. Waiting for third-party aircraft or vessels to complete surveys, refuel, or transit on station would extend the length of the activity in a way that would diminish realism and delay training and testing schedules. Hiring third-party civilian vessels or aircraft to observe additional Navy training and testing activities would also be unsustainable due to the significant associated costs. Because many training and testing activities take place offshore, the amount of time observers would spend on station would be limited due to aircraft fuel restrictions. Fuel restrictions and distance from shore would increase safety risks should mechanical problems arise. The presence of civilian aircraft or vessels in the vicinity of training and testing activities would present increased safety risks due to airspace conflicts and proximity to explosives.

5.5.6 Foreign Navy Mitigation

When assessing and developing mitigation, the Navy considered adopting the mitigation measures implemented by foreign navies. Mitigation measures are carefully developed for and assessed by each individual navy based on the potential impacts of their activities on the biological resources that live in their Study Areas, and the practicality of mitigation implementation based on their training mission and testing program requirements and the resources available for mitigation. The U.S. Navy's readiness considerations differ from those of foreign navies based on each navy's strategic reach, global mission, country-specific legal requirements, and geographic considerations. Most non-U.S. navies do not possess an integrated strike group and do not have integrated training requirements. The U.S. Navy's training is built around the integrated warfare concept and is based on the U.S. Navy's capabilities, the threats faced, the operating environment, and the overall mission. For this reason, not all measures developed for foreign navies would be effective at reducing impacts of U.S. Navy training or testing, or practical to implement by the U.S. Navy (and vice versa). For example, some navies implement active sonar ramp-up as mitigation for marine mammals; however, as described in Section 5.5.1 (Active Sonar), the U.S. Navy determined that active sonar ramp-up would be an ineffective mitigation measure for training and testing activities under the Proposed Action and would be impractical to implement because it would significantly impact training and testing realism.

The U.S. Navy will implement the mitigation measures as described in Section 5.3 (Procedural Mitigation to be Implemented) and Section 5.4 (Mitigation Areas to be Implemented) because they have been determined to be effective at avoiding or reducing impacts from the Proposed Action and practical to implement by the U.S. Navy. Many of these measures are the same as, or comparable to, those implemented by foreign navies. For example, most navies implement some form of procedural mitigation to cease certain activities if a marine mammal is observed in a mitigation zone (Dolman et al., 2009). Some navies also implement geographic mitigation to restrict activities within particularly important marine mammal breeding, feeding, or migration habitats. The U.S. Navy will implement several mitigation measures and environmental compliance initiatives that are not implemented by foreign navies. For example, as discussed in Section 5.1.2.2 (Monitoring, Research, and Reporting

Initiatives), the U.S. Navy will continue to sponsor scientific monitoring and research and comply with stringent reporting requirements.

5.5.7 Reporting Requirements

When assessing and developing mitigation, the Navy considered increasing its reporting requirements, such as additional reporting of vessel speeds and marine species observations. As discussed in Section 5.1.2.2 (Monitoring, Research, and Reporting Initiatives), the Navy developed its reporting requirements in conjunction with NMFS and the USFWS to be consistent with mission requirements and balance the usefulness of the information to be collected with the practicality of collecting it. The Navy's training and testing activity reports and incident reports are designed to verify mitigation implementation; comply with current permits, authorizations, and consultation requirements; and improve future environmental analyses. The Navy reports to NMFS if mitigation was implemented during sinking exercises and ship shock trials (e.g., number of times explosive detonations were delayed due to marine mammal sightings). For major training exercises, the Navy's annual training and testing activity reports include information on each individual marine mammal sighting related to mitigation implementation. In the unlikely event a that a marine mammal vessel strike occurs, the Navy provides NMFS with relevant information pertaining to the incident, including but not limited to vessel speed.

Additional administrative reporting would be ineffective as mitigation because it would not result in modifications to training or testing activities or further avoidance or reductions of potential impacts. For example, additional administrative reporting of vessel speed data would not result in modifications to vessel speeds (e.g., speed restrictions) or reduce the already low potential for marine mammal vessel strikes. Lookouts are not trained to make species-specific identification and would not be able to provide detailed scientific data if more detailed marine species observation reports were to be required. Furthermore, the Navy does not currently maintain a record management system to collect, archive, analyze, and report marine species observation or vessel speed data for every training and testing activity and all vessel movements. For example, the speed of Navy vessels can fluctuate an unlimited number of times during training and testing events. Developing and implementing a record management system of this magnitude would be unduly cost prohibitive and place a significant administrative burden on vessel operators and activity participants. Burdening operational Commanders, vessel operators, and event participations with requirements to complete additional administrative reporting would distract them from preparing a ready force and focusing on mission-essential tasks. Additional reporting requirements would draw event participants' attention away from the complex tactical tasks they are primarily obligated to perform, such as driving a warship or engaging in a gunnery event, which would adversely impact Navy personnel safety, public safety, and the effectiveness of training or testing.

As part of the U.S. Navy Marine Species Monitoring Program, the Navy conducted 5 years of monitoring before, during, and after several types of events involving the use of explosives in the Study Area. For example, the Navy submitted annual marine mammal monitoring reports for mine neutralization exercises in the Virginia Capes Range Complex under its Phase I and Phase II MMPA permits. These reports were designed, in part, to address if the Navy's mitigation measures for explosives were effective at avoiding injury and mortality of marine mammals. The Navy's monitoring reports detailed all marine mammal sightings and if mitigation was implemented during each event. The Navy did not observe any dead or injured marine mammals during these monitoring events. There has not been a demonstrated utility for, or benefit of, continuing to collect and report similar marine species observation and mitigation data for training and testing activities under the Proposed Action.

5.5.8 Permission Schemes

Following publication of the 2013 Hawaii-Southern California Training and Testing (HSTT) Final EIS/OEIS, a 2015 settlement agreement temporarily prohibited or restricted Navy activities within specific areas in the HSTT Study Area. The temporary settlement measures were derived pursuant to negotiations with plaintiffs and were not evaluated or selected based on the type of thorough examination of best available science that occurs through the consultation process under the MMPA, or through analysis conducted for NEPA purposes. The temporary settlement agreement did not constitute a concession by the Navy as to the potential impacts of its activities on marine mammals or other species. The settlement terms do not extend ad infinitum, were agreed to only for the purpose of settling the lawsuit, and were never intended to be a framework for how the Navy develops future mitigation.

The Navy's adoption of temporary restrictions on its activities as part of a relatively short-term settlement does not mean that those restrictions are supported by the best available science or are practical to implement from a military readiness standpoint over the longer term in either the HSTT Study Area or other Study Areas, such as AFTT. For example, an activity permission scheme is impractical and unwarranted in the AFTT Study Area based on the extensive level of Navy Senior Leadership review and approval of mitigation measures that will be implemented under the Proposed Action. The mitigation measures described in Section 5.3 (Procedural Mitigation to be Implemented) and Section 5.4 (Mitigation Areas to be Implemented) were reviewed and approved by a four-star Admiral, the Fleet Commander of all Navy forces in the Study Area, and Navy Senior Leadership; therefore, additional permission or authorization from Navy Leadership prior to conducting training or testing in the Study Area would be redundant.

As described in Chapter 2 (Description of Proposed Action and Alternatives) and Chapter 3 (Affected Environment and Environmental Consequences), the Navy conducts thousands of discrete training and testing activities, many involving active sonar and explosives. In most cases, activities are small-scale unit-level training activities or testing events with minor potential to impact the environment. To require that each individual event be approved at an elevated level of command would essentially paralyze Navy decision-making as senior Commanders would be focused on approving otherwise minor and minimally impactful activities. For major training exercises, senior Commanders are already part of the planning and approval processes. Burdening operational Commanders with requirements to complete additional administrative tasks would distract them from preparing a ready force. At the most fundamental level, a training and testing activity permission scheme within the AFTT Study Area would run counter to one of the foundational concepts of naval command and control at sea, which is the ability and duty for a commanding officer to train and fight their ship. Requiring additional permission for training and testing activities in the AFTT Study Area would be impractical because it would not be compatible with meeting the purpose and need of the Proposed Action. The Navy will continue to institutionalize mitigation procedures and tools to facilitate Navywide environmental compliance and reduce administrative burdens, such as the Protective Measures Assessment Protocol discussed in Section 5.2 (Mitigation Development Process) and Section 5.3.1 (Environmental Awareness and Education).

5.6 Mitigation Summary

Table 5.6-1 and Table 5.6-2 summarize the mitigation measures that the Navy will implement under Alternative 1 or Alternative 2 of the Proposed Action. Figure 5.6-1 displays the mitigation areas in the Study Area. Unless specified otherwise in the tables, the mitigation applies year-round. For specific requirements, additional information, and clarifications to the table summaries, see Section 5.3 (Procedural Mitigation to be Implemented) and Section 5.4 (Mitigation Areas to be Implemented).

Table 5.6-1: Summary of Procedural Mitigation

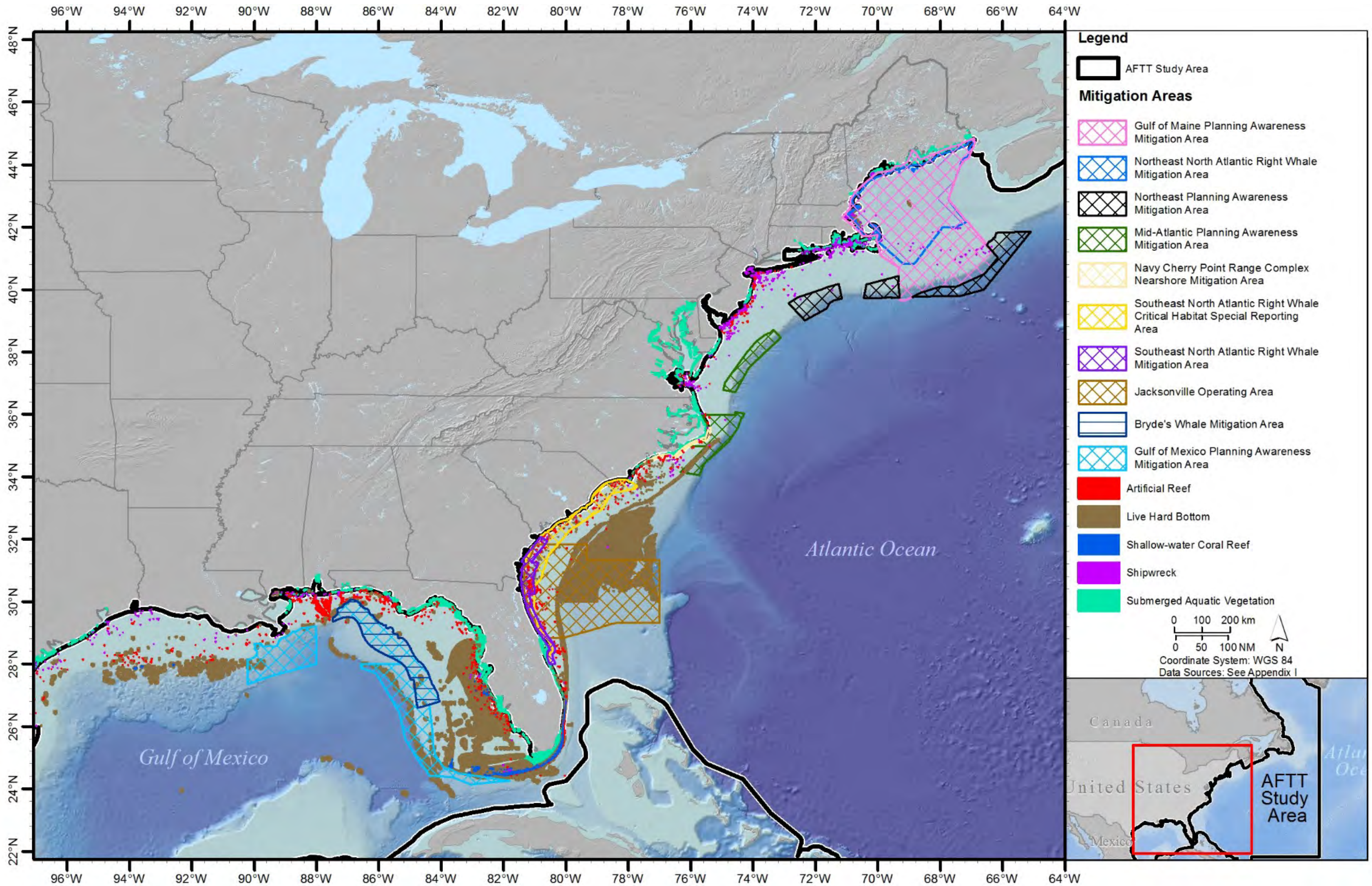
Stressor or Activity	*Mitigation Zones Sizes and Other Requirements*	*Protection Focus*
Environmental Awareness and Education	• Afloat Environmental Compliance Training program for applicable personnel	Marine mammals, Sea turtles
Active Sonar	Depending on sonar source: • 1,000 yd. power down, 500 yd. power down, and 200 yd. shut down • 200 yd. shut down	Marine mammals, Sea turtles
Air Guns	• 150 yd.	Marine mammals, Sea turtles
Pile Driving	• 100 yd.	Marine mammals, Sea turtles
Weapons Firing Noise	• 30° on either side of the firing line out to 70 yd.	Marine mammals, Sea turtles
Aircraft Overflight Noise	• Distance from shore in the Virginia Capes Range Complex and Fisherman Island National Wildlife Refuge during explosive mine neutralization activities involving Navy divers (piping plovers and other nesting birds) • Distance from shore in the Dry Tortugas Islands for supersonic flights (Fort Jefferson and roseate terns)	Birds, Cultural resources
Explosive Sonobuoys	• 600 yd.	Marine mammals, Sea turtles
Explosive Torpedoes	• 2,100 yd.	Marine mammals, Sea turtles
Explosive Medium-Caliber and Large-Caliber Projectiles	• 1,000 yd. (large-caliber projectiles) • 600 yd. (medium-caliber projectiles during surface-to-surface activities) • 200 yd. (medium-caliber projectiles during air-to-surface activities)	Marine mammals, Sea turtles
Explosive Missiles and Rockets	• 2,000 yd. (21–500 lb. net explosive weight) • 900 yd. (0.6–20 lb. net explosive weight)	Marine mammals, Sea turtles
Explosive Bombs	• 2,500 yd.	Marine mammals, Sea turtles
Sinking Exercises	• 2.5 NM	Marine mammals, Sea turtles
Explosive Mine Countermeasure and Neutralization Activities	• 2,100 yd. (6–650 lb. net explosive weight) • 600 yd. (0.1–5 lb. net explosive weight)	Marine mammals, Sea turtles
Explosive Mine Neutralization Activities Involving Navy Divers	• 1,000 yd. (21–60 lb. net explosive weight for positive control charges and charges using time-delay fuses) • 500 yd. (0.1–20 lb. net explosive weight for positive control charges)	Marine mammals, Sea turtles
Maritime Security Operations – Anti-Swimmer Grenades	• 200 yd.	Marine mammals, Sea turtles
Line Charge Testing	• 900 yd.	Marine mammals, Sea turtles, Gulf sturgeon
Ship Shock Trials	• 3.5 NM	Marine mammals, Sea turtles
Vessel Movement	• 500 yd. (whales) • 200 yd. (other marine mammals) • Vicinity (sea turtles) • North Atlantic right whale Dynamic Management Area notification messages	Marine mammals, Sea turtles
Towed In-Water Devices	• 250 yd. (marine mammals) • Vicinity (sea turtles)	Marine mammals, Sea turtles
Small-, Medium-, and Large-Caliber Non-Explosive Practice Munitions	• 200 yd.	Marine mammals, Sea turtles
Non-Explosive Missiles and Rockets	• 900 yd.	Marine mammals, Sea turtles
Non-Explosive Bombs and Mine Shapes	• 1,000 yd.	Marine mammals, Sea turtles

Table 5.6-2: Summary of Mitigation Areas

Summary of Mitigation Area Requirements
Mitigation Areas for Shallow-water Coral Reefs
• The Navy will not conduct precision anchoring (except in designated anchorages), explosive or non-explosive mine countermeasure and neutralization activities, explosive or non-explosive mine neutralization activities involving Navy divers, explosive or non-explosive small-, medium-, and large-caliber gunnery activities using a surface target, explosive or non-explosive missile and rocket activities using a surface target, or explosive or non-explosive bombing or mine laying activities. • The Navy will not place mine shapes, anchors, or mooring devices on the seafloor. • Within the Key West Range Complex, vessels will operate within waters deep enough to avoid bottom scouring or prop dredging, with at least a 1-ft. clearance between the deepest draft of the vessel (with the motor down) and the seafloor at mean low water. • Within the South Florida Ocean Measurement Facility Testing Range, the Navy will implement additional measures for shallow-water coral reefs, such as using real-time positioning and remote sensing information to avoid shallow-water coral reefs during deployment, installation, and recovery of anchors and mine-like objects, and during deployment of bottom-crawling unmanned underwater vehicles.
Mitigation Areas for Live Hard Bottom, Artificial Reefs, Submerged Aquatic Vegetation, and Shipwrecks
• The Navy will not conduct precision anchoring (except in designated anchorages), explosive mine countermeasure and neutralization activities, or explosive mine neutralization activities involving Navy divers, and will not place mine shapes, anchors, or mooring devices on the seafloor (except in designated locations). • Within the Key West Range Complex, vessels will operate within waters deep enough to avoid bottom scouring or prop dredging, with at least a 1-ft. clearance between the deepest draft of the vessel (with the motor down) and the seafloor at mean low water. • Within the South Florida Ocean Measurement Facility Testing Range, the Navy will implement additional measures for live hard bottom, such as using real-time positioning and remote sensing information to avoid live hard bottom during deployment, installation, and recovery of anchors and mine-like objects, and during deployment of bottom-crawling unmanned underwater vehicles.
Northeast North Atlantic Right Whale Mitigation Area
• The Navy will report the total hours and counts of active sonar and in-water explosives used in the mitigation area in its annual training and testing activity reports. • The Navy will minimize use of active sonar to the maximum extent practicable and will not use explosives that detonate in the water. • The Navy will conduct non-explosive torpedo testing during daylight hours in Beaufort sea state 3 or less using three Lookouts (one on a vessel, two in an aircraft during aerial surveys) and an additional Lookout on the submarine when surfaced; during transits, ships will maintain a speed of no more than 10 knots; during firing, ships will maintain a speed of no more than 18 knots except brief periods of time during vessel target firing. • Vessels will obtain the latest North Atlantic right whale sightings data and implement speed reductions after they observe a North Atlantic right whale, if within 5 NM of a sighting reported within the past week, and when operating at night or during periods of reduced visibility.
Gulf of Maine Planning Awareness Mitigation Area
• The Navy will report the total hours and counts of active sonar and in-water explosives used in the mitigation area in its annual training and testing activity reports. • The Navy will not conduct major training exercises and will not conduct >200 hours of hull-mounted mid-frequency active sonar per year.
Northeast Planning Awareness Mitigation Areas and Mid-Atlantic Planning Awareness Mitigation Areas
• The Navy will avoid conducting major training exercises to the maximum extent practicable. • The Navy will not conduct more than four major training exercises per year.
Southeast North Atlantic Right Whale Mitigation Area (November 15 – April 15)
• The Navy will report the total hours and counts of active sonar and in-water explosives used in the mitigation area in its annual training and testing activity reports. • The Navy will not use active sonar except as necessary for navigation training, object detection training, and dipping sonar. • The Navy will not expend explosive or non-explosive ordnance. • Vessels will obtain the latest North Atlantic right whale sightings data; will implement speed reductions after they observe a North Atlantic right whale, if within 5 NM of a sighting reported within the past 12 hours, and when operating at night or during periods of reduced visibility; and will minimize north-south transits to the maximum extent practicable.
Jacksonville Operating Area (November 15 – April 15)
• Navy units conducting training or testing activities in the Jacksonville Operating Area will obtain and use Early Warning System North Atlantic right whale sightings data as they plan specific details of events to minimize potential interactions with North Atlantic right whales to the maximum extent practicable. The Navy will use the reported sightings information to assist visual observations of applicable mitigation zones and to aid in the implementation of procedural mitigation.
Southeast North Atlantic Right Whale Critical Habitat Special Reporting Area (November 15 – April 15)
• The Navy will report the total hours and counts of active sonar and in-water explosives used in the mitigation area in its annual training and testing activity reports.

Table 5.6-2: Summary of Mitigation Areas (continued)

Summary of Mitigation Area Requirements
Navy Cherry Point Range Complex Nearshore Mitigation Area (March – September)
• The Navy will not conduct explosive mine neutralization activities involving Navy divers in the mitigation area. • To the maximum extent practicable, the Navy will not use explosive sonobuoys, explosive torpedoes, explosive medium-caliber and large-caliber projectiles, explosive missiles and rockets, explosive bombs, explosive mines during mine countermeasure and neutralization activities, and anti-swimmer grenades in the mitigation area.
Bryde's Whale Mitigation Area
• The Navy will report the total hours and counts of active sonar and in-water explosives used in the mitigation area in its annual training and testing activity reports. • The Navy will not conduct >200 hours of hull-mounted mid-frequency active sonar per year and will not use explosives (except during explosive mine warfare activities).
Gulf of Mexico Planning Awareness Mitigation Areas
• The Navy will avoid conducting major training exercises to the maximum extent practicable. • The Navy will not conduct any major training exercises under Alternative 1 and no more than one per year under Alternative 2.



Notes: AFTT: Atlantic Fleet Training and Testing

Figure 5.6-1: Summary of Mitigation Areas in the Study Area

References

Agler, B. A., R. L. Schooley, S. E. Frohock, S. K. Katona, and I. E. Seipt. (1993). Reproduction of photographically identified fin whales, *Balaenoptera physalus*, from the Gulf of Maine. *Journal of Mammalogy, 74*, 577–587.

Azzellino, A., S. Gaspari, S. Airoldi, and B. Nani. (2008). Habitat use and preferences of cetaceans along the continental slope and the adjacent pelagic waters in the western Ligurian Sea. *Deep Sea Research Part I: Oceanographic Research Papers, 55*(3), 296–323.

Baird, R. W., D. L. Webster, Z. Swaim, H. J. Foley, D. B. Anderson, and A. J. Read. (2016). *Spatial Use by Odontocetes Satellite Tagged off Cape Hatteras, North Carolina in 2015. Final report*. Virginia Beach, VA: U.S. Fleet Forces Command.

Baird, R. W., D. L. Webster, Z. T. Swaim, H. J. Foley, D. B. Anderson, and A. J. Read. (2018). *Spatial Use by Cuvier's Beaked Whales and Short-finned Pilot Whales Satellite Tagged off Cape Hatteras, North Carolina: 2017 Annual Progress Report*. Virginia Beach, VA: U.S. Fleet Forces Command.

Balmer, B. C., R. S. Wells, S. M. Nowacek, D. P. Nowacek, L. H. Schwake, W. A. McLellan, F. S. Scharf, T. K. Rowles, L. J. Hansen, T. R. Spradlin, and D. A. Pabst. (2008). Seasonal abundance and distribution patterns of common bottlenose dolphins (*Tursiops truncatus*) near St. Joseph Bay, Florida, USA. *Journal of Cetacean Research and Management, 10*(2), 157–167.

Baumgartner, M. F., K. D. Mullin, L. N. May, and T. D. Leming. (2001). Cetacean habitats in the northern Gulf of Mexico. *Fishery Bulletin, 99*, 219–239.

Baumgartner, M. F., and B. R. Mate. (2003). Summertime foraging ecology of North Atlantic right whales. *Marine Ecology Progress Series, 264*, 123–135.

Baumgartner, M. F., C. T. V. N., R. G. Campbell, G. J. Teegarden, and E. G. Durbin. (2003). Associations between North Atlantic right whales and their prey, *Calanus finmarchicus*, over diel and tidal time scales. *Marine Ecology Progress Series, 264*, 155–166.

Baumgartner, M. F., and D. M. Fratantoni. (2008). Diel periodicity in both sei whale vocalization rates and the vertical migration of their copepod prey observed from ocean gliders. *Limnology and Oceanography, 53*(5part2), 2197–2209.

Baumgartner, M. F., N. S. J. Lysiak, C. Schuman, J. Urban-Rich, and F. W. Wenzel. (2011). Diel vertical migration behavior of *Calanus finmarchicus* and its influence on right and sei whale occurrence. *Marine Ecology Progress Series, 423*, 167–184.

Biggs, D. C., A. E. Jochens, M. K. Howard, S. F. DiMarco, K. D. Mullin, R. R. Leben, F. E. Muller-Karger, and C. Hu. (2005). Eddy forced variations in on- and off-margin summertime circulation along the 1000-m isobath of the northern Gulf of Mexico, 2000–2003, and links with sperm whale distributions along the middle slope. *Geophysical Monograph Series, 161*, 71–85.

Boebel, O. (2017). *Exploring the Termal Limits of IR-Based Automatic Whale Detection*. Arlington, VA: Office of Naval Research Program.

Bort, J., S. M. Van Parijs, P. T. Stevick, E. Summers, and S. Todd. (2015). North Atlantic right whale *Eubalaena glacialis* vocalization patterns in the central Gulf of Maine from October 2009 through October 2010. *Endangered Species Research, 26*(3), 271–280.

Brown, M. W., D. Fenton, K. Smedbol, C. Merriman, K. Robichaud-Leblanc, and J. D. Conway. (2009). *Recovery Strategy for the North Atlantic Right Whale (Eubalaena glacialis) in Atlantic Canadian Waters* (Species at Risk Act Recovery Strategy Series). Ottawa, ON: Fisheries and Oceans Canada.

Cetacean and Turtle Assessment Program. (1982). *Characterization of Marine Mammals and Turtles in the Mid- and North Atlantic Areas of the U.S. Outer Continental Shelf*. (Contract Number AA551-CT8-48). Kingston, RI: University of Rhode Island, Graduate School of Oceanography.

Charif, R. A., C. S. Oedekoven, A. Rahaman, B. J. Estabrook, L. Thomas, and A. N. Rice. (2015). *Development of Statistical Methods for Assessing Changes in Whale Vocal Behavior in Response to Mid-Frequency Active Sonar. Final Report*. Virginia Beach, VA: U.S. Fleet Forces Command.

Clapham, P. J., and C. A. Mayo. (1987). Reproduction and recruitment of individually identified humpback whales, *Megaptera novaeangliae*, observed in Massachusetts Bay, 1979-1985. *Canadian Journal of Zoology, 65*(12), 2853–2863.

Clapham, P. J., and D. K. Mattila. (1990). Humpback whale songs as indicators of migration routes. *Marine Mammal Science, 6*(2), 155–160.

Clapham, P. J., L. S. Baraff, C. A. Carlson, M. A. Christian, D. K. Mattila, C. A. Mayo, M. A. Murphy, and S. Pittman. (1993). Seasonal occurrence and annual return of humpback whales, *Megaptera novaeangliae*, in the southern Gulf of Maine. *Canadian Journal of Zoology, 71*(2), 440–443.

Cole, T. V. N., P. K. Hamilton, A. Henry, P. A. Duley, R. M. Pace, III, B. N. White, and T. R. Frasier. (2013). Evidence of a North Atlantic right whale *Eubalaena glacialis* mating ground. *Endangered Species Research, 21*, 55–64.

Davis, R. W., and G. S. Fargion. (1996). *Distribution and Abundance of Marine Mammals in the North-central and Western Gulf of Mexico*. Galveston, TX: U.S. Department of the Interior, Minerals Management Service.

Davis, R. W., G. S. Fargion, N. May, T. D. Leming, M. Baumgartner, W. E. Evans, L. J. Hansen, and K. Mullin. (1998). Physical habitat of cetaceans along the continental slope in the north-central and western Gulf of Mexico. *Marine Mammal Science, 14*(3), 490–507.

Davis, R. W., W. E. Evans, and B. Würsig, (Eds.). (2000). *Cetaceans, Sea Turtles and Seabirds in the Northern Gulf of Mexico: Distribution, Abundance and Habitat Associations*. New Orleans, LA: U.S. Department of the Interior, Minerals Management Service.

Dolman, S. J., C. R. Weir, and M. Jasny. (2009). Comparative review of marine mammal guidance implemented during naval exercises. *Marine Pollution Bulletin, 58*, 465–477.

Dunlop, R. A., M. J. Noad, R. D. McCauley, E. Kniest, R. Slade, D. Paton, and D. H. Cato. (2016). Response of humpback whales (*Megaptera novaeangliae*) to ramp-up of a small experimental air gun array. *Marine Pollution Bulletin, 103*(1–2), 72–83.

Flinn, R. D., A. W. Trites, and E. J. Gregr. (2002). Diets of fin, sei, and sperm whales in British Columbia: An analysis of commercial whaling records, 1963–1967. *Marine Mammal Science, 18*(3), 663–679.

Foley, H., Z. Swaim, D. Waples, and A. Read. (2015). *Deep Divers and Satellite Tagging Projects in the Virginia Capes OPAREA - Cape Hatteras, NC: January 2014–December 2014*. Virginia Beach, VA: U.S. Fleet Forces Command.

Garrison, L. P. (2007). *Defining the North Atlantic Right Whale Calving Habitat in the Southeastern United States: An Application of a Habitat Model* (National Oceanic and Atmospheric Administration Technical Memorandum). Miami, FL: Southeast Fisheries Science Center.

Gaskin, D. E. (1977). *Harbour porpoise, Phocoena phocoena (L.), in the western approaches to the Bay of Fundy 1969–75* (Report of the International Whaling Commission). Silver Spring, MD: National Oceanic and Atmospheric Administration.

Good, C. P. (2008). *Spatial ecology of the North Atlantic right whale (Eubalaena glacialis).* (PhD dissertation). Duke University, Durham, NC.

Gowan, T. A., and J. G. Ortega-Ortiz. (2014). Wintering habitat model for the North Atlantic right whale (*Eubalaena glacialis*) in the southeastern United States. *PLoS ONE, 9*(4), e95126.

Hain, J. H. W., M. J. Ratnaswamy, R. D. Kenney, and H. E. Winn. (1992). The fin whale, *Balaenoptera physalus*, in waters of the northeastern United States continental shelf. *Reports of the International Whaling Commission, 42*, 653–670.

Hamazaki, T. (2002). Spatiotemporal prediction models of cetacean habitats in the mid-western North Atlantic Ocean (from Cape Hatteras, North Carolina, U.S.A. to Nova Scotia, Canada). *Marine Mammal Science, 18*(4), 920–939.

Hamilton, P. K., and C. A. Mayo. (1990). *Population characteristics of right whales (Eubalaena glacialis) observed in Cape Cod and Massachusetts Bays, 1978–1986* (Reports of the International Whaling Commission, Special Issue). Cambridge, United Kingdom: International Whaling Commission.

Hamilton, P. K., A. R. Knowlton, and M. K. Marx. (2007). Right whales tell their own stories: The photo-identification catalog. In S. D. Kraus & R. M. Rolland (Eds.), *The Urban Whale: North Atlantic Right Whales at a Crossroads* (pp. 75–104). Cambridge, MA: Harvard University Press.

Hansen, L. J., K. D. Mullin, and C. L. Roden. (1995). *Estimates of Cetacean Abundance in the Northern Gulf of Mexico from Vessel Surveys*. Miami, FL: Southeast Fisheries Science Center.

Hansen, L. J., K. D. Mullin, T. A. Jefferson, and G. P. Scott. (1996). *Visual Surveys Aboard Ships and Aircraft* (Distribution and Abundance of Marine Mammals in the Northcentral and Western Gulf of Mexico). New Orleans, LA: U.S. Department of the Interior, Mineral Management Service.

Hanson, C. E., K. W. King, M. E. Eagan, and R. D. Horonjeff. (1991). *Aircraft Noise Effects on Cultural Resources: Review of Technical Literature*. (290940.04-1). Lexington, MA: M. Harris, Miller & Hanson, Inc.

Hazen, E. L., A. S. Friedlaender, M. A. Thompson, C. R. Ware, M. T. Weinrich, P. N. Halpin, and D. N. Wiley. (2009). Fine-scale prey aggregations and foraging ecology of humpback whales, *Megaptera novaeangliae*. *Marine Ecology Progress Series, 395*, 75–89.

Hodge, K. B., C. A. Muirhead, J. L. Morano, C. W. Clark, and A. N. Rice. (2015). North Atlantic right whale occurrence near wind energy areas along the mid-Atlantic US coast: Implications for management. *Endangered Species Research, 28*, 225–234.

Hodge, L., J. Stanistreet, and A. Read. (2016). *Passive Acoustic Monitoring for Marine Mammals at Site A in Norfolk Canyon, June 2014–April 2015*. Norfolk, VA: Naval Facilities Engineering Command Atlantic.

James, M., M. Downing, K. Bradley, and J. Gearrelick. (2009). *Sonic Boom Structural Damage Potential for Fort Jefferson at Dry Tortugas National Park*. Fort Jefferson, FL: Blue Ridge Research and Consulting, LLC and Applied Physical Sciences Inc.

Jefferson, T. A., and A. J. Schiro. (1997). Distribution of cetaceans in the offshore Gulf of Mexico. *Mammal Review, 27*, 27–50.

Jefferson, T. A., M. A. Webber, and R. L. Pitman. (2015). *Marine Mammals of the World: A Comprehensive Guide to Their Identification* (2nd ed.). Cambridge, MA: Academic Press.

Jochens, A., D. Biggs, D. Engelhaupt, J. Gordon, C. Hu, N. Jaquet, M. Johnson, R. Leben, B. Mate, P. Miller, J. Ortega-Ortiz, A. Thode, P. Tyack, and B. Wursig. (2008). *Sperm Whale Seismic Study in the Gulf of Mexico: Synthesis Report*. New Orleans, LA: U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico Outer Continental Shelf Region.

Jonsgard, A., and K. Darling. (1977). *On the biology of the eastern North Atlantic sei whale, Balenoptera borealis lesson*. Washington, DC: International Whaling Commission.

Keller, C. A., L. I. Ward-Geiger, W. B. Brooks, C. K. Slay, C. R. Taylor, and B. J. Zoodsma. (2006). North Atlantic right whale distribution in relation to sea-surface temperature in the southeastern United States calving grounds. *Marine Mammal Science, 22*(2), 426–445.

Keller, C. A., L. I. Ward-Geiger, W. B. Brooks, C. K. Slay, C. R. Taylor, and B. J. Zoodsma. (2012). Application of a habitat model to define calving habitat of the North Atlantic right whale in the southeastern United States. *Endangered Species Research, 18*, 73–87.

Kenney, R. D., M. A. M. Hyman, R. E. Owen, G. P. Scott, and H. E. Winn. (1986). Estimation of prey densities required by western North Atlantic right whales. *Marine Mammal Science, 2*(1), 1–13.

Kenney, R. D., and H. E. Winn. (1986). Cetacean high-use habitats of the northeast United States continental shelf. *Fishery Bulletin, 84*(2), 345–357.

Kenney, R. D., H. E. Winn, and M. C. Macaulay. (1995). Cetacean in the Great South Channel, 1979-1989: right whale (*Eubalaena glacialis*). *Continental Shelf Research, 15*, 385–414.

Kenney, R. D. (2008). Right Whales (*Eubalaena glacialis, E. japonica*, and *E. australis*). In W. F. Perrin, B. Wursig, & J. G. M. Thewissen (Eds.), *Encyclopedia of Marine Mammals* (2nd ed., pp. 962–972). Cambridge, MA: Academic Press.

Knowlton, A. R., S. D. Kraus, and R. D. Kenney. (1994). Reproduction in North Atlantic right whales (*Eubalaena glacialis*). *Canadian Journal of Zoology, 72*, 1297–1305.

Kraus, S. D., J. H. Prescott, and G. S. Stone. (1983). *Harbor Porpoise, Phocoena phocoena, in the U.S. Coastal Waters off the Gulf of Maine: A survey to Determine Seasonal Distribution and Abundance*. Boston, MA: National Marine Fisheries Service.

Kraus, S. D., R. M. Pace, and T. R. Frasier. (2007). *High Investment, Low Return: The Strange Case of Reproduction in Eubalaena glacialis*. Cambridge, MA: Harvard University Press.

LaBrecque, E., C. Curtice, J. Harrison, S. M. Van Parijs, and P. N. Halpin. (2015a). Biologically Important Areas for Cetaceans Within U.S. Waters—Gulf of Mexico Region. *Aquatic Mammals, 41*(1), 30–38.

LaBrecque, E., C. Curtice, J. Harrison, S. M. Van Parijs, and P. N. Halpin. (2015b). Biologically Important Areas for Cetaceans Within U.S. Waters—East Coast Region. *Aquatic Mammals, 41*(1), 17–29.

Longley, K. (2012). *Investigating the Role of an Understudied North Atlantic Right Whale Habitat: Right Whale Movement, Ecology, and Distribution in Jeffreys Ledge.* (Graduate Masters Thesis). University of Massachusetts. Retrieved from https://scholarworks.umb.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1106&context=masters_theses.

Mackey, A. D. (2010). *Site fidelity and association patterns of bottlenose dolphins (Tursiops truncatus) in the Mississippi Sound.* (Unpublished doctoral dissertation). University of Southern Mississippi, Hattiesburg, MS.

Maloni, M., J. A. Paul, and D. M. Gligor. (2013). Slow steaming impacts on ocean carriers and shippers. *Maritime Economics & Logistics, 15*(2), 151–171.

Mayo, C. A., O. C. Nichols, M. K. Bessinger, M. K. Marx, C. L. Browning, and M. W. Brown. (2004). *Surveillance, Monitoring and Management of North Atlantic Right Whales in Cape Cod Bay and Adjacent Waters - 2004*. Provincetown, MA: Center for Coastal Studies.

Maze-Foley, K., and K. D. Mullin. (2006). Cetaceans of the oceanic northern Gulf of Mexico: Distributions, group sizes and interspecific associations. *Journal of Cetacean Research and Management, 8*(2), 203–213.

McAlarney, R., E. Cummings, W. McLellan, and D. A. Pabst. (2016). *Aerial Surveys for Protected Species in the Cape Hatteras and Norfolk Canyon Regions: 2015 Annual Progress Report*. Virginia Beach, VA: Naval Facilities Engineering Command Atlantic.

McLellan, W. A., E. Meagher, L. Torres, G. Lovewell, C. Harper, K. Irish, B. Pike, and A. D. Pabst. (2004). *Winter right whale sightings from aerial surveys of the coastal waters of the U.S. Mid-Atlantic*. Paper presented at the 15th Biennial Conference on the Biology of Marine Mammals.

Mizroch, S. A., D. W. Rice, and J. M. Brewick. (1984a). The fin whale, *Balaenoptera physalus*. *Marine Fisheries Review, 46*(4), 20–24.

Mizroch, S. A., D. W. Rice, and J. M. Brewick. (1984b). The sei whale, *Balaenoptera borealis*. *Marine Fisheries Review, 46*(4), 25–29.

Morano, J. L., A. N. Rice, J. T. Tielens, B. J. Estabrook, A. Murray, B. L. Roberts, and C. W. Clark. (2012a). Acoustically detected year-round presence of right whales in an urbanized migration corridor. *Conservation Biology, 26*(4), 698–707.

Morano, J. L., D. P. Salisbury, A. N. Rice, K. L. Conklin, K. L. Falk, and C. W. Clark. (2012b). Seasonal and geographical patterns of fin whale song in the western North Atlantic Ocean. *The Journal of the Acoustical Society of America, 132*(2), 1207–1212.

Mullin, K. D., L. V. Higgins, T. A. Jefferson, and L. J. Hansen. (1994a). Sightings of the Clymene dolphin (*Stenella clymene*) in the Gulf of Mexico. *Marine Mammal Science, 10*(4), 464–470.

Mullin, K. D., W. Hoggard, C. L. Roden, R. R. Lohoefener, and C. M. Rogers. (1994b). Cetaceans on the upper continental slope in the north-central Gulf of Mexico. *Fishery Bulletin, 92*(4), 773–786.

Mullin, K. D., and W. Hoggard. (2000). *Visual surveys of cetaceans and sea turtles from aircraft and ships* (Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations). New Orleans, LA: Minerals Management Service.

Mullin, K. D., and G. L. Fulling. (2004). Abundance of cetaceans in the oceanic northern Gulf of Mexico, 1996–2001. *Marine Mammal Science, 20*(4), 787–807.

Mullin, K. D., W. Hoggard, and L. J. Hansen. (2004). Abundance and seasonal occurrence of cetaceans in outer continental shelf and slope waters of the north-central and northwestern Gulf of Mexico. *Gulf of Mexico Science, 22*(1), 62–73.

Murphy, M. A. (1995). Occurrence and group characterisitics of minke whales, *Balaenoptera acutorostrata*, in Massachusetts Bay and Cape Cod Bay. *Fishery Bulletin, 93*, 577–585.

Mussoline, S. E., D. Risch, L. T. Hatch, M. T. Weinrich, D. N. Wiley, M. A. Thompson, P. J. Corkeron, and S. M. Van Parijs. (2012). Seasonal and diel variation in North Atlantic right whale up-calls: Implications for management and conservation in the northwestern Atlantic Ocean. *Endangered Species Research, 17*, 17–26.

National Marine Fisheries Service. (2008). *Compliance Guide for Right Whale Ship Strike Reduction Rule (50 C.F.R. 224.105)*. Silver Spring, MD: National Oceanic and Atmospheric Administration. Retrieved from http://www.nmfs.noaa.gov/pr/pdfs/shipstrike/compliance_guide.pdf.

National Marine Fisheries Service. (2009a). *Environmental Assessment, Regulatory Impact Review, and Final Regulatory Flexibility Analysis for the Final Pelagic Longline Take Reduction Plan*. St. Petersburg, FL: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

National Marine Fisheries Service. (2009b). *Sperm Whale (Physeter macrocephalus): 5-Year Review: Summary and Evaluation*. Silver Spring, MD: National Marine Fisheries Service Office of Protected Resources.

National Marine Fisheries Service. (2011). *2011 Annual Report to a Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in US Waters of the Western North Atlantic Ocean*. Woods Hole, MA and Miami, FL: Northeast Fisheries Science Center and Southeast Fisheries Science Center.

National Marine Fisheries Service. (2013). *Cruise results NOAA ship Gordon Gunter cruise GU 12-02(67) 7 June–6 August 2012, southeast Gulf of Mexico sperm whale study*. Pascagoula, MS: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, and the National Marine Fisheries Service, Mississippi Laboratories.

National Marine Fisheries Service. (2014). *2014 Annual Report to a Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in U.S. Waters of the Western North Atlantic Ocean*. Woods Hole, MA and Miami, FL: Northeast Fisheries Science Center and Southeast Fisheries Science Center.

National Oceanic and Atmospheric Administration. (2012). *North Atlantic right whale (Eubalaena glacialis) 5-year review: Summary and evaluation*. Gloucester, MA: Northeast Regional Office.

National Oceanic and Atmospheric Administration. (2015). *2015 Annual Report to a Comprehensive Assessment of Marine Mammal, Marine Turtle, and Seabird Abundance and Spatial Distribution in U.S. Waters of the Western North Atlantic Ocean–AMAPPS II*. Woods Hole, MA and Miami, FL: Northeast Fisheries Science Center and Southeast Fisheries Science Center.

Oedekoven, C., E. Fleishman, P. Hamilton, J. S. Clark, and R. S. Schick. (2015). Expert elicitation of seasonal abundance of North Atlantic right whales *Eubalaena glacialis* in the mid-Atlantic. *Endangered Species Research, 29*, 51–58.

Pace, R. M., III, and R. L. Merrick. (2008). Northwest Atlantic Ocean habitats important to the conservation of North Atlantic right whales (*Eubalaena glacialis*). *Northeast Fisheries Science Center Reference Document* (08–07), 30.

Palka, D. (1995a). Influences on spatial patterns of Gulf of Maine harbor porpoises. *Developments in Marine Biology, 4*, 69–75.

Palka, D. L. (1995b). Abundance estimate of Gulf of Maine harbor porpoise. *Report of the International Whaling Commision, 16*, 27–50.

Palka, D. L. (2000). *Abundance of the Gulf of Maine/Bay of Fundy Harbor Porpoise Based on Shipboard and Aerial Surveys during 1999*. Woods Hole, MA: Northeast Fisheries Science Center.

Palka, D. L. (2012). *Cetacean Abundance Estimates in U.S. Northwestern Atlantic Ocean Waters from Summer 2011 Line Transect Survey*: U.S. Department of Commerce, Northeast Fisheries Science Center Reference Document 12–29. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://www.nefsc.noaa.gov/nefsc/publications/.

Panigada, S., M. Zanardelli, M. Mackenzie, C. Donovan, F. Melin, and P. S. Hammond. (2008). Modelling habitat preferences for fin whales and striped dolphins in the Pelagos Sanctuary (Western Mediterranean Sea) with physiographic and remote sensing variables. *Remote Sensing of Environment, 112*(8), 3400–3412.

Paquet, D., C. Haycock, and H. Whitehead. (1997). Numbers and seasonal occurrence of humpback whales (*Megaptera novaeangliae*) off Brier Island, Nova Scotia. *Canadian Field-Naturalist, 11*, 548–552.

Patrician, M. R., I. S. Biedron, H. C. Esch, F. W. Wenzel, L. A. Cooper, P. K. Hamilton, A. H. Glass, and M. F. Baumgartner. (2009). Evidence of a North Atlantic right whale calf (*Eubalaena glacialis*) born in northeastern U.S. waters. *Marine Mammal Science, 25*(2), 462–477.

Payne, P. M., J. R. Nicolas, L. O'Brien, and K. D. Powers. (1986). The distribution of the humpback whale, *Megaptera novaeangliae*, on Georges Bank and in the Gulf of Maine in relation to densities of the sand eel, *Ammodytes americanus*. *Fishery Bulletin, 84*(2), 271–278.

Payne, P. M., D. W. Heinemann, and L. A. Selzer. (1990a). *A Distributional Assessment of Cetaceans in Shelf/Shelf-Edge and Adjacent Slope Waters of the Northeastern United States Based on Aerial and Shipboard Surveys, 1978–1988*. Woods Hole, MA: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center.

Payne, P. M., D. N. Wiley, S. B. Young, S. Pittman, P. J. Clapham, and J. W. Jossi. (1990b). Recent fluctuations in the abundance of baleen whales in the southern Gulf of Maine in relation to changes in selected prey. *Fishery Bulletin, 88*(4), 687–696.

Prieto, R., D. Janiger, M. Silva, G. T. Waring, and J. M. Goncalves. (2012). The forgotten whale: a bibliometric analysis and literature review of the North Atlantic sei whale *Balaenoptera borealis*. *Mammal Review, 42*(3), 235–272.

Read, A. J., and A. J. Westgate. (1997). Monitoring the movements of harbour porpoises (*Phocoena phocoena*) with satellite telemetry. *Marine Biology, 130*, 315–322.

Risch, D., C. W. Clark, P. J. Dugan, M. Popescu, U. Siebert, and S. M. Van Parijs. (2013). Minke whale acoustic behaviour and multi-year seasonal and diel vocalization patterns in Massachusetts Bay, USA. *Marine Ecology Progress Series, 489*, 279–295.

Roberts, J. J., B. D. Best, L. Mannocci, E. Fujioka, P. N. Halpin, D. L. Palka, L. P. Garrison, K. D. Mullin, T. V. N. Cole, C. B. Khan, W. A. McLellan, D. A. Pabst, and G. G. Lockhart. (2016). Habitat-based cetacean density models for the U.S. Atlantic and Gulf of Mexico. *Scientific Reports, 6*, 22615.

Rosel, P. E., and L. A. Wilcox. (2014). Genetic evidence reveals a unique lineage of Bryde's whales in the northern Gulf of Mexico. *Endangered Species Research, 25*, 19–34.

Rosel, P. E., P. Corkeron, L. Engleby, D. Epperson, K. D. Mullin, M. S. Soldevilla, and B. L. Taylor. (2016). *Status Review of Byrde's Whales (Balaenopter edeni) in the Gulf of Mexico Under the Endangered Species Act* (NOAA Technical Memorandum NMFS-SEFSC-692). Lafayette, LA: Southeast Fisheries Science Center.

Ruiz-Cooley, R. I., and D. Engelhaupt. (2010). *Trophic aspects of sperm whales (Physeter macrocephalus) in the northern Gulf of Mexico using stable isotopes of carbon and nitrogen*. New Orleans, LA: U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico Outer Continental Shelf Region.

Salisbury, D. P., C. W. Clark, and A. N. Rice. (2015). Right whale occurrence in the coastal waters of Virginia, U.S.A.: Endangered species presence in a rapidly developing energy market. *Marine Mammal Science, 32*(2), 508–519.

Schick, R. S., P. N. Halpin, A. J. Read, C. K. Slay, S. D. Kraus, B. R. Mate, M. F. Baumgartner, J. J. Roberts, B. D. Best, C. P. Good, S. R. Loarie, and J. S. Clark. (2009). Striking the right balance in right whale conservation. *Canadian Journal of Fisheries and Aquatic Sciences, 66*, 1399–1403.

Schilling, M. R., I. Seipt, M. T. Weinrich, S. E. Frohock, A. E. Kuhlberg, and P. J. Clapham. (1992). Behavior of individually identified sei whales, *Balaenoptera borealis,* during an episodic influx into the southern Gulf of Maine in 1986. *Fishery Bulletin, 90*, 749–755.

Seipt, I. E., P. J. Clapham, C. A. Mayo, and M. P. Hawvermale. (1990). Population characteristics of individually identified fin whales (*Balaenoptera physalus*) in Massachusetts Bay. *Fishery Bulletin, 88*(2), 271–278.

Silva, M. A., R. Prieto, I. Jonsen, M. F. Baumgartner, and R. S. Santos. (2013). North Atlantic blue and fin whales suspend their spring migration to forage in middle latitudes: Building up energy reserves for the journey? *PLoS ONE, 8*(10), e76507.

Širović, A., H. R. Bassett, S. C. Johnson, S. M. Wiggins, and J. A. Hildebrand. (2014). Bryde's whale calls recorded in the Gulf of Mexico. *Marine Mammal Science, 30*(1), 399–409.

Soldevilla, M. S., A. N. Rice, C. W. Clark, and L. P. Garrison. (2014). Passive acoustic monitoring on the North Atlantic right whale calving grounds. *Endangered Species Research, 25*, 115–140.

Speakman, T., E. Zolman, J. Adams, R. H. Defran, D. Laska, L. Schwacke, J. Craigie, and P. Fair. (2006). *Temporal and Spatial Aspects of Bottlenose Dolphin Occurrence in Coastal and Estuarine Waters near Charleston, South Carolina*. Charleston, SC: National Oceanic and Atmospheric Administration, National Ocean Service, National Centers for Coastal Ocean Science.

Stevick, P. T., J. Allen, P. J. Clapham, S. K. Katona, F. Larsen, J. Lien, D. K. Mattila, P. J. Palsboll, R. Sears, J. Sigurjonsson, T. D. Smith, G. Vikingsson, N. Oien, and P. S. Hammond. (2006). Population spatial structuring on the feeding grounds in North Atlantic humpback whales (*Megaptera novaeangliae*). *Journal of Zoology, 270*, 244–255.

Thorne, L. H., H. J. Foley, R. W. Baird, D. L. Webster, Z. T. Swaim, and A. J. Read. (2017). Movement and foraging behavior of short-finned pilot whales in the Mid-Atlantic Bight: Importance of bathymetric features and implications for management. *Marine Ecological Progress Series, 584*(245–257).

U.S. Department of the Navy. (2010). *Navy Integrated Comprehensive Monitoring Plan*. Washington, DC: U.S. Department of the Navy.

U.S. Department of the Navy. (2011). *Marine Species Monitoring for the U.S. Navy's Virginia Capes, Cherry Point and Jacksonville Range Complexes; Annual Report for 2010*. Norfolk, VA: United States Fleet Forces Command.

U.S. Department of the Navy. (2013). *U.S. Navy Strategic Planning Process for Marine Species Monitoring*. Washington, DC: Chief of Naval Operations, Energy & Environmental Readiness Division.

U.S. Department of the Navy. (2014). *Marine Species Monitoring Report for the U.S. Navy's Atlantic Fleet Active Sonar Training (AFAST) and Virginia Capes, Cherry Point, Jacksonville, and Gulf of Mexico Range Complexes - Annual Report 2013*. Norfolk, VA: United States Fleet Forces Command.

U.S. Department of the Navy. (2017a). *Marine Mammal Strandings Associated with U.S. Navy Sonar Activities*. San Diego, CA: U.S. Navy Marine Mammal Program and SPAWAR Naval Facilities Engineering Command.

U.S. Department of the Navy. (2017b). *U.S. Navy Marine Species Density Database Phase III for the Atlantic Fleet Training and Testing Study Area* (Naval Facilities Engineering Command Atlantic Technical Report). Norfolk, VA: Naval Facilities Engineering Command Atlantic.

U.S. Department of the Navy. (2017c). *Dive Distribution and Group Size Parameters for Marine Species Occurring in the U.S. Navy's Atlantic and Hawaii-Southern California Training and Testing Study Areas*. Newport, RI: Naval Undersea Warfare Center Division.

U.S. Department of the Navy. (2017d). *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)*. San Diego, CA: Space and Naval Warfare System Command, Pacific.

U.S. Department of the Navy. (2018a). *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (Technical Report prepared by NUWC Division Newport, Space and Naval Warfare Systems Center Pacific, G2 Software Systems, and the National Marine Mammal Foundation). Newport, RI: Naval Undersea Warfare Center.

U.S. Department of the Navy. (2018b). *Building and Maintaining a Comprehensive Database and Prioritization Scheme for Overlapping Habitat Data – Focus on Abiotic Substrates in the Atlantic Fleet Training and Testing Study Area*. (Phase III AFTT Benthic Habitat Database Technical Report). Washington, DC: Naval Facilities Engineering Command.

von Benda-Beckmann, A. M., P. J. Wensveen, P. H. Kvadsheim, F. P. Lam, P. J. Miller, P. L. Tyack, and M. A. Ainslie. (2014). Modeling effectiveness of gradual increases in source level to mitigate effects of sonar on marine mammals. *Conservation Biology, 28*(1), 119–128.

Waring, G. T., E. Josephson, K. Maze-Foley, and P. E. Rosel. (2014). *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments–2013* (NOAA Technical Memorandum NMFS-NE-228). Woods Hole, MA: U.S. Department of Commerce, National Marine Fisheries Service.

Waring, G. T., K. Maze-Foley, and P. E. Rosel, (Eds.). (2015). *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments–2014* (NOAA Technical Memorandum NMFS-NE-231). Woods Hole, MA: U.S. Department of Commerce, National Marine Fisheries Service.

Waring, G. T., E. Josephson, K. Maze-Foley, P. E. Rosel, B. Byrd, T. V. N. Cole, L. Engleby, L. P. Garrison, J. Hatch, A. Henry, S. C. Horstman, J. Litz, M. C. Lyssikatos, K. D. Mullin, C. Orphanides, R. M. Pace, D. L. Palka, M. Soldevilla, and F. W. Wenzel. (2016). *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments–2015* (NOAA Technical Memorandum NMFS-NE-238). Woods Hole, MA: U.S. Department of Commerce, National Marine Fisheries Service.

Weinrich, M., M. Martin, R. Griffiths, J. Bove, and M. Schilling. (1997). A shift in distribution of humpback whales, *Megaptera novaeangliae*, in response to prey in the southern Gulf of Maine. *Fishery Bulletin, 95*(4), 826–836.

Weinrich, M. T., and A. E. Kuhlberg. (1991). Short-term association patterns of humpback whale (*Megaptera novaeangliae*) groups on their feeding grounds in the southern Gulf of Maine. *Canadian Journal of Zoology, 69*(12), 3005–3011.

Weinrich, M. T., R. D. Kenney, and P. K. Hamilton. (2000). Right whales (*Eubalaena glacialis*) on Jeffreys Ledge: A habitat of unrecognized importance? . *Marine Mammal Science, 16*(2), 326–337.

Weinrich, M. T., K. Sardi, and C. Pekarcik. (2005). *Fall boat-based surveys on Jeffrey's Ledge for North Atlantic right whales distribution, abundance, behavior, ecology, photo-identification: a semi-annual report, September 1, 2004−March 1, 2005* (Submitted in fulfillment of award number: NA04NMF4720401). Gloucester, MA: The New England Whale Center of New England.

Weller, D. W. (1998). *Global and regional variation in the biology and behavior of bottlenose dolphins* (PhD. Dissertation). Texas A&M University, College Station, TX.

Weller, D. W., B. Wursig, S. K. Lynn, and A. J. Schiro. (2000). Preliminary findings on the occurrence and site fidelity of photo-identified sperm whales (*Physeter macrocephalus*) in the northern Gulf of Mexico. *Gulf of Mexico Science, 18*(1), 35–39.

Wensveen, P. J., P. H. Kvadsheim, F.-P. A. Lam, A. M. Von Benda-Beckmann, L. D. Sivle, F. Visser, C. Curé, P. Tyack, and P. J. O. Miller. (2017). Lack of behavioural responses of humpback whales (*Megaptera novaeangliae*) indicate limited effectiveness of sonar mitigation. *The Journal of Experimental Biology, 220*, 1–12.

Whitehead, H. (1982). Populations of humpback whales in the northwest Atlantic. *Reports of the International Whaling Commission, 32*, 345–353.

Whitt, A. D., K. Dudzinski, and J. R. Laliberté. (2013). North Atlantic right whale distribution and seasonal occurrence in nearshore waters off New Jersey, USA, and implications for management. *Endangered Species Research, 20*(1), 59–69.

Williams, B. K., R. C. Szaro, and C. D. Shapiro. (2009). *Adaptive Management: The U.S. Department of the Interior Technical Guide*. Washington, DC: U.S. Department of the Interior.

Winn, H. E., J. D. Goodyear, R. D. Kenney, and R. O. Petricig. (1995). Dive patterns of tagged right whales in the Great South Channel. *Continental Shelf Research, 15*(4-5), 593–611.

Würsig, B., T. A. Jefferson, and D. J. Schmidly. (2000). *The Marine Mammals of the Gulf of Mexico*. College Station, TX: Texas A&M University Press.

Zitterbart, D. P., L. Kindermann, E. Burkhardt, and O. Boebel. (2013). Automatic round-the-clock detection of whales for mitigation from underwater noise impacts. *PLoS ONE, 8*(8), e71217.

This page intentionally left blank.

Final
Environmental Impact Statement/Overseas Environmental Impact Statement
Atlantic Fleet Training and Testing

TABLE OF CONTENTS

List of Figures

List of Tables

6 REGULATORY CONSIDERATIONS

In accordance with the Council on Environmental Quality regulations for implementing the National Environmental Policy Act (NEPA), federal agencies shall, to the fullest extent possible, integrate the requirements of NEPA with other planning and environmental review procedures required by law or by agency practice so that all such procedures run concurrently rather than consecutively. This chapter summarizes environmental compliance for the Proposed Action, consistency with other federal, state, and local plans, policies, and regulations not considered in Chapter 3 (Affected Environment and Environmental Consequences); the relationship between short-term impacts and the maintenance and enhancement of long-term productivity in the affected environment; irreversible and irretrievable commitments of resources; and energy conservation.

6.1 CONSISTENCY WITH REGULATORY CONSIDERATIONS

Implementation of the Proposed Action for the Atlantic Fleet Training and Testing (AFTT) Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS), would comply with applicable federal, state, and local laws, regulations, and executive orders. The United States (U.S.) Department of the Navy (Navy) is consulting with and will continue to consult with regulatory agencies, as appropriate, during the NEPA process and prior to implementation of the Proposed Action to ensure that requirements are met. Table 6.1-1 summarizes the additional environmental compliance requirements not specifically assessed in the resource chapters. Documentation of consultation and coordination with regulatory agencies is provided in Appendix J (Agency Correspondence).

Table 6.1-1: Summary of Environmental Compliance for the Proposed Action

Laws, Executive Orders, International Standards, and Guidance	***Status of Compliance***
LAWS	
Abandoned Shipwreck Act (43 United States Code [U.S.C.] sections 2101-2106)	For abandoned shipwrecks in U.S. Territorial Waters, the federal government asserts title to the resource. See Section 3.10 (Cultural Resources) for assessment and conclusion that the Proposed Action is consistent with the act.
Act to Prevent Pollution from Ships (33 U.S.C. sections 1901-1915)	The Act to Prevent Pollution from Ships applies to U.S. vessels worldwide and implements the requirements of annexes I (Oil Pollution), II (Noxious Liquid Substances Carried in Bulk), V (Ship-Generated Garbage), and VI (Air Pollution) of the International Convention for the Prevention of Pollution from Ships for the United States. This act excludes warships and naval auxiliaries from the preventive measures in annexes I, II, and VI. Annex V requires Navy ships and submarines to comply fully with discharge restrictions applicable outside of "special areas" designated under annex V and places limitations on Navy ship discharges within annex V special areas. Requirements associated with the Act to Prevent Pollution from Ships are implemented in accordance with the *Navy Environmental and Natural Resources Program Manual* and related Navy guidance documents governing waste management, pollution prevention, and recycling. At sea, the Navy complies with these policies and operates in a manner that minimizes or eliminates any adverse effects to the marine environment. See Section 3.2 (Sediments and Water Quality) for the assessment.
Antiquities Act (16 U.S.C. sections 431-433)	In accordance with Navy procedures, the Proposed Action is consistent with the act's objectives for protection of archaeological and historical sites and objects, preservation of cultural resources, and the public's access to them. See Section 3.10 (Cultural Resources) for the assessment.
Coastal Zone Management Act (16 U.S.C. sections 1451-1464)	The Navy has complied with the coastal zone federal consistency requirements for those states/territories whose coastal uses or resources may be affected by the Proposed Action (as discussed in Section 6.1.1).
Historic Sites Act (16 U.S.C. sections 461–467)	In accordance with Navy procedures, the Proposed Action is consistent with the national policy for the preservation of historic sites, buildings, and objects of national significance. See Chapter 3.10 (Cultural Resources) for the assessment.
Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. sections 1801–1882)	The Navy has prepared an Essential Fish Habitat Assessment as a separate document. The Proposed Action will have an adverse effect on Essential Fish Habitat and managed species. The Navy consulted with the National Marine Fisheries Service (NMFS) for affected species and their habitats (as discussed in Section 6.1.3).
Migratory Bird Treaty Act (16 U.S.C. sections 703–712)	Implementation of the Proposed Action is not anticipated to result in significant adverse effects on migratory birds; therefore, the Navy does not need to confer with the U.S. Fish and Wildlife Service (USFWS). See Section 3.9 (Birds and Bats) for the assessment.

Table 6.1-1: Summary of Environmental Compliance for the Proposed Action (continued)

Laws, Executive Orders, International Standards, and Guidance	***Status of Compliance***
National Fishery Enhancement Act (33 U.S.C. sections 2101-2106)	The Proposed Action is consistent with regulations administered by NMFS and U.S. Army Corps of Engineers concerning artificial reefs in the navigable waters of the United States. Impacts to artificial reefs are covered in the Essential Fish Habitat Assessment.
National Historic Preservation Act (16 U.S.C. sections 470 et seq.)	The Navy consulted with State Historic Preservation Officers under Section 106 of this Act. See Section 3.10 (Cultural Resources) for the assessment.
National Marine Sanctuaries Act (16 U.S.C. sections 1431-1445c-1)	Five National Marine Sanctuaries administered by National Oceanic and Atmospheric Administration Office of National Marine Sanctuaries lie within the Study Area. These are discussed further in Section 6.1.2.6 (National Marine Sanctuaries). • Activities the Navy proposes to conduct in the Gerry E. Studds Stellwagen Bank National Marine Sanctuary are consistent with the activities considered when the Sanctuary was designated and are consistent with Navy activities and planning during the development of the most recent management plan. The Navy consulted under Section 304(d). • The Navy does not propose to conduct any new activities in the *Monitor* National Marine Sanctuary that would cause significant impacts on sanctuary resources. Furthermore, the Navy does not propose to increase the level of existing activities within the sanctuary from what was previously considered at the time of sanctuary designation. The Navy did not consult under Section 304(d). • Activities the Navy proposes to conduct in Gray's Reef National Marine Sanctuary are consistent with the activities exempted when the sanctuary was designated and are consistent with Navy activities and planning during the development of the most recent management plan. The Navy consulted under Section 304(d). • Activities the Navy proposes to conduct in the Florida Keys National Marine Sanctuary are within the classes of activities exempted from requiring a permit as of the effective date of the sanctuary regulations and are consistent with Navy activities and planning included in the most recent management plan. The Navy consulted under Section 304(d). • Activities the Navy proposes to conduct in Flower Garden Banks National Marine Sanctuary are consistent with the activities exempted when the sanctuary was designated and are consistent with Navy activities and planning during the development of the most recent management plan. The Navy did not consult under Section 304(d).

Table 6.1-1: Summary of Environmental Compliance for the Proposed Action (continued)

Laws, Executive Orders, International Standards, and Guidance	***Status of Compliance***
Resource Conservation and Recovery Act (42 U.S.C. section 6901 et seq.) / Military Munitions Rule	Under the Resource Conservation and Recovery Act, the Military Munitions Rule identifies when conventional and chemical military munitions are considered solid waste. Military munitions are not considered solid waste based on two conditions stated in the 40 Code of Federal Regulations (CFR) section 266.202(a)(1)(i-iii). Specifically, munitions are not considered hazardous waste when: 1. Used for their intended purpose, including training of military personnel and explosive emergency response specialists; research and development activities; and when recovered, collected, and destroyed during range clearance events. 2. Unused and being repaired, reused, recycled, reclaimed, disassembled, reconfigured, or subjected to other material recovery activities. These two conditions cover the uses of munitions included in the Proposed Action; therefore, the Resource Conservation and Recovery Act does not apply.
Rivers and Harbors Act (33 U.S.C. section 401 et seq.)	Under the Rivers and Harbors Act, a U.S. Army Corps of Engineers permit is required when construction is proposed in navigable waterways. The Navy will acquire U.S. Army Corps of Engineers permits where applicable.
Submerged Lands Act of 1953 (43 U.S.C. sections 1301–1315)	The Proposed Action occurs within state waters as released to state authority through the Submerged Lands Act. The U.S. retained navigable servitude and rights or powers in those waters for purposes of navigation and national defense among other uses. Therefore, the Navy's activities are compatible with the state's rights of ownership, management, leasing, use, and development of lands and natural resources recognized under the Submerged Lands Act.
Sunken Military Craft Act (Public Law 108–375, 10 U.S.C. section 113 Note and 118 Stat. 2094–2098)	The Sunken Military Craft Act does not apply to actions taken by, or at the direction of, the United States. See Section 3.10 (Cultural Resources) for the assessment.
R.M.S. Titanic Maritime Memorial Preservation Act (16 U.S.C. sections 450rr-450rr-6)	In accordance with Navy procedures, implementation of the Proposed Action would not affect efforts to designate the shipwreck of the R.M.S. *Titanic* as an international maritime memorial and the development of international guidelines for reasonable research, exploration, and, if appropriate salvage activities with respect to the shipwreck.
EXECUTIVE ORDERS	
Executive Order 11990, *Protection of Wetlands*	In accordance with Navy procedures, implementation of the Proposed Action would not affect wetlands as defined in Executive Order 11990. The action being analyzed takes place at sea; therefore, no terrestrial wetlands would be impacted by the Proposed Action. However, the Proposed Action does overlap with some areas that contain coastal and emergent wetlands. See Section 3.3 (Vegetation) for more details.
Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*	In accordance with Navy procedures, the Proposed Action would not result in any disproportionately high and adverse human health or environmental effects on minority or low-income populations. See Section 3.0.3.2 (Resources and Issues Eliminated from Further Consideration).

Table 6.1-1: Summary of Environmental Compliance for the Proposed Action (continued)

Laws, Executive Orders, International Standards, and Guidance	***Status of Compliance***
Executive Order 12962, *Recreational Fisheries*	In accordance with Navy procedures, the Proposed Action would not affect federal agencies' ability to fulfill certain duties with regard to promoting the health and access of the public to recreational fishing areas. See Section 3.11 (Socioeconomics) for the assessment.
Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks*	In accordance with Navy procedures, the Proposed Action would not result in disproportionate environmental health or safety risks to children. See Section 3.0.3.2 (Resources and Issues Eliminated from Further Consideration).
Executive Order 13089, *Coral Reef Protection*	The Navy has prepared this EIS/OEIS in accordance with requirements that federal agencies whose actions affect U.S. coral reef ecosystems shall provide for the implementation of measures needed to research, monitor, manage, and restore them, including reducing impacts from pollution and sedimentation. See Section 3.4 (Invertebrates) for the assessment.
Executive Order 13112, *Invasive Species*	In accordance with Navy procedures, the Proposed Action would not increase the number of or introduce new invasive species nor require the Navy to take measures to avoid introduction and spread of those species. Naval vessels are exempt from 33 CFR Part 151 Subpart D, *Ballast Water Management for Control of Nonindigenous Species in Waters of the United States*; however, the Navy follows ballast water protocols as required by DoD Manual 4716.60 Volume 3.
Executive Order 13158, *Marine Protected Areas*	The Navy has prepared this EIS/OEIS in accordance with requirements for the protection of existing national system of marine protected areas. See Section 6.1.2 (Marine Protected Areas) for more information.
Executive Order 13175, *Consultation and Coordination with Indian Tribal Governments*	In accordance with Navy procedures, the Proposed Action would not have substantial direct effects on one or more Indian tribes, on the relationship between the federal government and Indian tribes, or on the distribution of power and responsibilities between the federal government and Indian tribes. See Section 8.4.4 (Federally-Recognized Tribes) for federally-recognized tribes that were provided notification letters of the AFTT EIS/OEIS.
Executive Order 13840, *Ocean Policy to Advance the Economic, Security, and Environmental Interests of the United States*	The Proposed Action is consistent with the National Ocean Policy to Advance the Economic, Security, and Environmental Interests of the United States.
Executive Order 13834, *Efficient Federal Operations*	The Proposed Action is consistent with the federal government's goals to reduce waste, cut costs, enhance the resilience of federal infrastructure and operations, and enable more effective accomplishment of its mission.
INTERNATIONAL STANDARDS	
International Convention for the Prevention of Pollution from Ships	The Proposed Action does include vessel operation and incidental discharges from ships; however, Navy vessels operating in the Study Area comply with applicable law and regulations, minimizing or eliminating potential impact from discharges from ships.

6.1.1 Coastal Zone Management Act Compliance

The Coastal Zone Management Act of 1972 (16 U.S.C. sections 1451-1464) encourages coastal states to be proactive in managing coastal zone uses and resources. The act established a voluntary coastal planning program and required participating states to submit a Coastal Management Plan to the National Oceanic and Atmospheric Administration for approval. Under the act, federal actions that have an effect on a coastal use or resources are required to be consistent, to the maximum extent practicable, with the enforceable policies of federally approved Coastal Management Plans.

The Coastal Zone Management Act defines the coastal zone as extending offshore "to the outer limit of State title and ownership under the Submerged Lands Act" (i.e., 3 nautical miles [NM] from the shoreline, 9 NM for the west coast of Florida, Texas, and Puerto Rico). The coastal zone extends inland only to the extent necessary to control the shoreline, but the inland extent is not relevant to the Proposed Action.

A federal agency may submit a consistency determination, a negative determination, or a *de minimis* exemption for review of their activities. A federal agency submits a consistency determination when it determines that its activity may have either a direct or an indirect reasonably foreseeable effect on a state coastal use or resource. The consistency determination should include a brief statement indicating whether the proposed activity will be undertaken in a manner consistent to the maximum extent practicable with the enforceable policies of the management program according to15 CFR section 930.39. The consistency determination should be based on evaluation of the relevant enforceable policies of the management program. According to 15 CFR section 930.35, "if a Federal agency determines that there will not be coastal effects, then the Federal agency shall provide the State agencies with a negative determination for a Federal agency activity: (1) Identified by a State agency on its list, as described in section 930.34(b), or through case-by-case monitoring of unlisted activities; or (2) Which is the same as or is similar to activities for which consistency determinations have been prepared in the past; or (3) For which the Federal agency undertook a thorough consistency assessment and developed initial findings on the coastal effects of the activity." Thus, a negative determination must be submitted to a state if the agency determines no coastal effects and one or more of the triggers above is met. *De minimis* exemptions are activities proposed by the federal agency that have already been reviewed and approved by the state (after allowing for public review and comment), and those that the state has recognized as having insignificant direct or indirect (secondary or cumulative) effects on its coastal resources.

In accordance with the Coastal Zone Management Act, the Navy has reviewed the enforceable policies of each state's federally approved Coastal Zone Management Plan relevant to the Study Area. There are 18 states (Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Louisiana, Mississippi, and Texas) and two U.S. territories (Puerto Rico and U.S. Virgin Islands) whose coastal zones are located within the Study Area. The Navy determined that no activities are proposed within or in proximity to the coastal zones of Puerto Rico and the U.S. Virgin Islands, and therefore no activities would cause reasonably foreseeable effects on coastal uses or resources against which to analyze enforceable policies. As such, the Navy was not required to submit a negative determination pursuant to 15 CFR 930.35. The remaining states do include activities within or in proximity to the activities proposed that may have reasonably foreseeable effects on coastal uses or resources, and are therefore subject to consistency requirements. Based on an evaluation of the effects of the Proposed Action discussed in this EIS/OEIS and the enforceable policies of each state's Coastal Zone Management Plan, and pursuant to 15 CFR section 930.39, the Navy submitted consistency determinations to each of the 18 states in March of 2018. The Navy either received concurrence or assumed concurrence (due to lack of response, in accordance with 15 CFR section 930.41) from 16 of the 18 states. Delaware provided conditional concurrence, to which the Navy and Delaware agreed upon clarification of the condition. Georgia objected to the Navy's consistency determination. A series of exchanges between the Navy and Georgia were unable to result in Georgia withdrawing its objection. The Navy notified Georgia, pursuant to 15 CFR 930.43, with its intent to proceed with the Proposed Action over the state's objection. Official correspondence between the Navy and each of the state agencies is provided in Appendix J.

6.1.2 Marine Protected Areas

Many areas of the marine environment have some level of federal, state, or local management or protection. Marine protected areas are designated and managed at all levels of government by a variety of agencies and have been established by more than 100 legal authorities. Marine protected areas vary widely in purpose, managing agencies, management approaches, level of protection, and restrictions on human uses. They have been designated to achieve objectives ranging from the conservation of biodiversity, to the preservation of sunken historic vessels, to the protection of spawning species important to commercial and recreational fisheries. The levels of protection provided by these marine protected areas range from fully protected reserves (i.e., no take of any species is permitted) to sites allowing multiple uses including fishing, recreation, and industrial uses (National Marine Protected Areas Center, 2008).

Executive Order 13158, *Marine Protected Areas* (*Federal Register* 65(105): 34909-34911, May 26, 2000), directs the National Oceanic and Atmospheric Administration to establish a National Marine Protected Areas Center charged with developing a national system of marine protected areas, and with maintaining a list of sites formally accepted into the national system. A full list of areas accepted in the national system of marine protected areas is available from the National Marine Protected Areas Center. Executive Order 13158 requires each federal agency whose actions affect the natural or cultural resources protected by a marine protected area to identify such actions, and in taking such actions, avoid harm to those natural and cultural resources to the maximum extent practicable. Pursuant to Section 5 of Executive Order 13158, agency requirements apply only to the natural or cultural resources specifically afforded protection by the sites recognized in the List of National System Marine Protected Areas (National Marine Protected Areas Center, 2013). Although many sites contain coastal (within the continental shelf) lands and islands, only the resources of the protected coastal and ocean waters, and the submerged lands thereunder, are subject to Section 5 of Executive Order 13158 (National Park Service, 2006a).

All resources of the marine protected areas located within the Study Area have been incorporated into the analyses in Sections 3.1 (Air Quality), 3.2 (Sediments and Water Quality), 3.3 (Vegetation), 3.4 (Invertebrates), 3.5 (Habitats), 3.6 (Fishes), 3.7 (Marine Mammals), 3.8 (Reptiles), and 3.9 (Birds and Bats). In accordance with Executive Order 13158, the Navy has considered the potential impacts of its proposed activities under the Preferred Alternative (Alternative 1) to the national system of marine protected areas that contain marine waters within the Study Area, factoring in Navy standard operating procedures and mitigation when applicable to the stressor and resource. The Navy implements standard operating procedures for aircraft safety, which involves pilots of Navy aircraft making every attempt to avoid large flocks of birds to reduce the safety risk involved with a potential bird strike. Since 2011, the Navy has required that all Navy flying units report all bird strikes through the Web-Enabled Safety System Aviation Mishap and Hazard Reporting System. The standard operating procedures for aircraft safety could result in a secondary benefit to birds through a reduction in the potential for aircraft strike. The Navy also has several standard operating procedures for vessel safety. For example, ships operated by or for the Navy have personnel assigned to stand watch at all times, day and night, when moving through the water (underway). Watch personnel undertake extensive training in accordance with the U.S. Navy Lookout Training Handbook or civilian equivalent. A primary duty of watch personnel is to ensure safety of the ship, and this includes the requirement to detect and report all objects and disturbances sighted in the water that may be indicative of a threat to the ship and its crew, such as debris, a periscope, surfaced submarine, or surface disturbance. Per standard operating procedures, watch personnel also report any marine mammals sighted that have the potential to be in the direct path of the ship as a standard collision avoidance procedure. The Navy also implements mitigation measures to avoid or reduce the potential for vessel strikes, including maneuvering to avoid marine mammals and sea turtles. Navy vessels are required to operate in accordance with applicable navigation rules, including Inland Navigation Rules (33 CFR 83) and International Regulations for Preventing Collisions at Sea (72 COLREGS). These rules require that vessels at all times proceed at a safe speed so that proper and effective action can be taken to avoid collision and so they can be stopped within a distance appropriate to the prevailing circumstances and conditions. The standard operating procedures for vessel safety could result in a secondary benefit to marine species through a reduction in the potential for vessel strike. For a full discussion of standard operating procedures, see Section 2.3.3 (Standard Operating Procedures).

In addition to standard operating procedures, the Navy will implement mitigation to avoid potential impacts from sonar, explosives, and physical disturbance and strike stressors on applicable resources. For example, as described in Section 5.3.4 (Physical Disturbance and Strike Stressors), mitigation for vessel movements includes training Lookouts and watch personnel with the Marine Species Awareness Training (which provides information on sighting cues, visual observation tools and techniques, and sighting notification procedures), and requiring underway vessels to maneuver to maintain a specified distance from marine mammals and maneuver to avoid marine mammals and sea turtles. For a full discussion of mitigation, see Chapter 5 (Mitigation).

Table 6.1-2 presents information on the national system of marine protected areas located in the Study Area, as well as the training and testing activities that could occur within each area. As described in Chapter 2 (Description of Proposed Action and Alternatives), many training and testing activities could occur anywhere in the Study Area with proper range clearance (See Figure 2.3-1 and Table 2.3-5). These activities include:

- air warfare testing (air combat maneuver test; air platform/vehicle testing; intelligence, surveillance, and reconnaissance [does not typically occur in the coastal zone]);
- anti-submarine warfare (non-explosive torpedo exercise could occur anywhere within the study area with proper range clearance; explosive torpedo exercise would only occur greater than 3 NM from shore; tracking exercise occurs anywhere in the study area where proper water depth [typically 120 ft. and greater] exists);
- electronic warfare operations;
- expeditionary warfare (dive and salvage operations; personnel insertion/extraction);
- mine warfare (mine countermeasure exercise – surface, - ship sonar; submarine mine exercise; marine mammal systems; mine neutralization; submarine launched mobile mining; civilian port defense);
- surface warfare (maritime security operations); and
- other training activities (sonar maintenance and system checks; submarine navigation; submarine under ice certification; waterborne training; surface ship object detection).

Because the activities listed above are unlikely to occur in shallow nearshore waters, the impacts of such activities on marine protected areas located nearshore will not be considered further in this document.

Military activities are sometimes exempted from the prohibitions applicable to marine protected areas. In cases where the military conducted activities within an area prior to its establishment as a marine protected area, those activities are often incorporated into the area's management plan. Management policies specific to military activities are described below for the five different types of marine protected areas found in the Study Area (Table 6.1-2). Marine protected areas (not including National Marine Sanctuaries) located within the Study Area are shown in Figure 6.1-1, Figure 6.1-2, Figure 6.1-3, and Figure 6.1-4. The National Marine Sanctuaries located within the Study Area are shown in Figure 6.1-5 and Figure 6.1-6.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area

Marine Protected Area	*Figure/ Reference Number*	*Location within the Study Area*	*Protection Focus*	*Summary of Relevant Regulations*	*Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations*
State and Territorial Marine Protected Areas					
Blue Crab Sanctuary (established in 1994; 2,448 square kilometers [km^2] in size)	Figure 6.1-1 (1)	Virginia: Chesapeake Bay; overlaps mine warfare training areas, borders the VACAPES Range Complex and VACAPES OPAREA, and abuts pierside location at Joint Expeditionary Base Little Creek, Virginia Beach, Virginia	Focal Resource (Blue crab [*Callinectes sapidus*])	State regulations apply. Harvest restrictions are not applicable to Navy activities (Virginia Marine Resources Commission, 2015).	Ship signature testing activities and surface ship and submarine sonar testing activities would occur pierside at Little Creek; however, these activities are not expected to impact the blue crab or Blue Crab Sanctuary.
Kiptopeke State Park (established in 1992; 2 km^2 in size)	Figure 6.1-1 (2)	Virginia: Lower Chesapeake Bay, 1 NM from mine warfare training area	Ecosystem (migratory birds)	State regulations apply: prohibited to cut or scar any plant or tree, or to collect any plant or animal, except as authorized by permit (Virginia State Parks, 2017).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Kiptopeke State Park.
Arrecifes de la Cordillera Natural Reserve (established in 1980; 101 km^2 in size)	Figure 6.1-4 (3)	Puerto Rico: Other AFTT Areas	Ecosystem (mangroves, lagoons, beaches, coral reefs)	Prohibited: access to islands that have colonies of nesting birds; camping (Arrecifes de la Cordillera Natural Reserve, 2009).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Arrecifes de la Cordillera Natural Reserve.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	*Figure/ Reference Number*	*Location within the Study Area*	*Protection Focus*	*Summary of Relevant Regulations*	*Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations*
Isla de Desecheo Marine Reserve (established in 2000; 6 km^2 in size)	Figure 6.1-4 (4)	Puerto Rico: Other AFTT Areas	Ecosystem (coral reefs)	Prohibited: taking of any species or resource from the Marine Reserve. No site-specific management plan is currently in place (National Oceanic and Atmospheric Administration, 2009).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Isla de Desecheo Marine Reserve.
Tres Palmas de Rincón Marine Reserve (established in 2004; 1 km^2 in size)	Figure 6.1-4 (5)	Puerto Rico: Other AFTT Areas	Focal Resource (Elkhorn coral [*Acropora palmata*])	Prohibited: modification of aquatic habitat that is essential for vulnerable species (Tres Palmas de Rincón Marine Reserve, 2009).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Tres Palmas de Rincón Marine Reserve.
St. Croix East End Marine Park (established in 2003; 150 km^2 in size)	Figure 6.1-4 (6)	U.S. Virgin Islands: Other AFTT Areas	Ecosystem (mangroves, reefs, invertebrates, seagrass beds, sea turtles)	State regulations apply, including designated areas in which no take of any resources is allowed; speed or other vessel restrictions; and restriction on the removal of coral or live rock (U.S. Virgin Islands Department of Planning and Natural Resources, 2002).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within St. Croix East End Marine Park.
St. Thomas East End Reserves (established in 2011; 9 km^2 in size)	Figure 6.1-4 (7)	U.S. Virgin Islands: Other AFTT Areas	Ecosystem (mangroves, reefs, seagrass beds)	Prohibited: vessel anchoring, except in designated zones, which is allowed for a maximum of 7 days (U.S. Virgin Islands Department of Planning and Natural Resources, 2011).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within St. Thomas East End Reserves.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	*Figure/ Reference Number*	*Location within the Study Area*	*Protection Focus*	*Summary of Relevant Regulations*	*Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations*
Federal/State Partnership Marine Protected Areas					
National Estuarine Research Reserves					
Waquoit Bay National Estuarine Research Reserve (established in 1988; 11 km^2 in size)	Figure 6.1-1 (8)	Massachusetts: Portion located within Naval Undersea Warfare Center Division Newport Testing Range	Ecosystem (coastal and estuarine habitats)	Prohibited: dredging in Areas of Critical Environmental Concern is prohibited except for the sole purpose of fisheries and wildlife management (Waquoit Bay National Estuarine Research Reserve, 2014).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Waquoit Bay National Estuarine Research Reserve.
Jacques Cousteau Estuarine Research Reserve (established in 1998; 480 km^2 in size)	Figure 6.1-1 (9)	New Jersey: Overlaps W-107 of the Atlantic City OPAREA, Northeast Range Complexes	Ecosystem (coastal and estuarine watershed, including habitat for migratory birds, wading birds, fish, and ESA listed birds, sea turtles and marine mammals)	Prohibited: most construction, dredging, and mining operations that would alter the shape of the ocean bottom or reduce fishery productivity (Jacques Cousteau National Estuarine Research Reserve, 2009).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Jacques Cousteau Estuarine Research Reserve.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	Figure/ Reference Number	Location within the Study Area	Protection Focus	Summary of Relevant Regulations	Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations
Guana Tolomato Matanzas National Estuarine Research Reserve (established in 1999; 260 km^2 in size)	Figure 6.1-2 (10)	Florida: Other AFTT Areas, bordering JAX OPAREA, mine warfare warning area W-158E of JAX Range Complex	Ecosystem (aquatic reserve for preservation of natural conditions and conservation of biodiversity, including ESA listed marine mammals, sea turtles, and shore birds)	No alteration of physical conditions within the reserve shall be permitted except for public navigation or to enhance the quality of the reserve. Other uses or human activity may be permitted if determined to be compatible (Guana Tolomato Matanzas National Estuarine Research Reserve, 2009).	Proposed activities that could reasonably be expected to occur in the area include: search and rescue and aircraft overflights. However, search and rescue activities and aircraft overflights are not likely to impact the area's protected natural resources. Therefore, no impacts are expected within Guana Tolomato Matanzas National Estuarine Research Reserve.
Rookery Bay National Estuarine Research Reserve (established in 1978; 391 km^2 in size)	Figure 6.1-2 (11)	Florida: Other AFTT Areas (within 10 NM of W-174 of Key West Range Complex)	Ecosystem (birds, fish, West Indian manatees [*Trichechus manatus*], sea turtles)	Prohibited: removing, damaging, or introducing any live animals or plants (except for fishing), or introducing any physical components from or to the reserve; use or possession of firearms; any activity that degrades ambient water quality; approaching islands beyond posted boundary areas in the vicinity of nesting birds; anchoring longer than 2 days (Florida Department of Environmental Protection, 2013).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within the Rookery Bay National Estuarine Research Reserve.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	*Figure/ Reference Number*	*Location within the Study Area*	*Protection Focus*	*Summary of Relevant Regulations*	*Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations*
Jobos Bay National Estuarine Research Reserve (established in 1981; 10 km^2 in size)	Figure 6.1-4 (12)	Puerto Rico: Other AFTT Areas	Ecosystem (mangroves, seagrass beds, coral reefs, manatees, sea turtles)	Prohibited: motor vehicles; anchoring of boats, unless in designated areas (Jobos Bay National Estuarine Research Reserve, 2008).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Jobos Bay National Estuarine Research Reserve.
Federal Marine Protected Areas					
National Wildlife Refuges					
Cross Island National Wildlife Refuge (established in 1980; 7 (km^2) in size)	Figure 6.1-1 (13)	Maine: Other AFTT Areas	Ecosystem (restoring and managing colonies of nesting seabirds)	Prohibited: Seabird islands are closed to the public during the nesting season, 1 April through 31 August (U.S. Fish and Wildlife Service, 2015f).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Cross Island National Wildlife Refuge.
Monomoy National Wildlife Refuge (established in 1944; 37 km^2 in size)	Figure 6.1-1 (14)	Massachusetts: Within 2 NM of Boston OPAREA, Northeast Range Complexes	Focal Resource (habitat for migratory birds, including the federally protected piping plover [*Charadrius melodus*] and roseate tern [*Sterna dougallii*])	Prohibited: destruction, disturbance and removal of wildlife, vegetation, and government property. Closed areas apply between 15 April and 15 September (U.S. Fish and Wildlife Service, 2015e).	Unmanned vehicle development and payload testing is planned to occur in proximity to this marine protected area. The resources protected by this area could also be briefly exposed to aircraft overflights. However, the proposed activities are not likely to impact the area's protected natural resources.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	*Figure/ Reference Number*	*Location within the Study Area*	*Protection Focus*	*Summary of Relevant Regulations*	*Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations*
Nomans Land Island National Wildlife Refuge (established in 1970; 3 km^2 in size)	Figure 6.1-1 (15)	Massachusetts: Located within Naval Undersea Warfare Center Division Newport Testing Range	Focal Resource (habitat for migratory birds)	Prohibited: any public use due to the potential safety risk of unexploded ordinance (U.S. Fish and Wildlife Service, 2013).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Nomans Land Island National Wildlife Refuge.
Cape May National Wildlife Refuge (established in 1989; 87 km^2 in size)	Figure 6.1-1 (16)	New Jersey: Other AFTT Areas	Ecosystem (nesting habitat for piping plover, shorebirds, and migratory birds)	Prohibited: disturbing, injuring, destroying, collecting plants, wildlife, or other natural objects (U.S. Fish and Wildlife Service, 2014a).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Cape May National Wildlife Refuge.
Chincoteague National Wildlife Refuge (established in 1943; 74 km^2 in size)	Figure 6.1-1 (17)	Virginia: Other AFTT Areas	Ecosystem (migratory birds)	Prohibited: disturbing or collecting plants and animals or artifacts; launching, landing or operating unmanned aircraft (U.S. Fish and Wildlife Service, 2016c).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Chincoteague National Wildlife Refuge.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	*Figure/ Reference Number*	*Location within the Study Area*	*Protection Focus*	*Summary of Relevant Regulations*	*Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations*
Fisherman Island National Wildlife Refuge (established in 1969; 9 km^2 in size)	Figure 6.1-1 (18)	Virginia: Lower Chesapeake Bay, 1 NM from mine warfare training area	Ecosystem (migratory birds)	Prohibited: commercial and recreational fishing (U.S. Fish and Wildlife Service, 2004).	The resources protected by this area could be briefly exposed to aircraft overflights; however, as discussed in Chapter 5 (Mitigation), the Navy will implement mitigation to avoid potential impacts from rotary-wing aircraft overflights on piping plovers and other nesting birds during explosive ordnance disposal activities, including maneuvering to maintain a specified distance from the beach within the Virginia Capes Range Complex (except when transiting from Norfolk Naval Station to waters offshore) and from Fisherman Island National Wildlife Refuge off the coast of Cape Charles, Virginia (when transiting from Norfolk Naval Station to waters offshore). Therefore, no impacts are expected within Fisherman Island National Wildlife Refuge.
Plum Tree Island National Wildlife Refuge (established in 1972; 20 km^2 in size)	Figure 6.1-1 (19)	Virginia: Other AFTT Areas	Focal Resource (estuarine habitats)	Prohibited: public use due to fragile habitats and safety concerns associated with former use as a bombing range; anchoring or bottom disturbance on refuge-owned bottoms (U.S. Fish and Wildlife Service, 2016b).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Plum Tree Island National Wildlife Refuge.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	*Figure/ Reference Number*	*Location within the Study Area*	*Protection Focus*	*Summary of Relevant Regulations*	*Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations*
Pea Island National Wildlife Refuge (established in 1937; 19 km^2 in size)	Figure 6.1-1 and Figure 6.1-2 (20)	North Carolina: Other AFTT Areas	Ecosystem (migratory birds and wetland protection)	Prohibited: taking, possessing, injuring, disturbing, damaging, destroying, or collecting any plant or animal (U.S. Fish and Wildlife Service, 2016a).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Pea Island National Wildlife Refuge.
Cape Romain National Wildlife Refuge (established in 1930; 248 km^2 in size)	Figure 6.1-2 (21)	South Carolina: Other AFTT Areas, 1 NM from Charleston OPAREA, Charleston mine warfare alternate location #3	Ecosystem (loggerhead sea turtle [*Caretta caretta*], waterfowl, and shorebirds including the piping plover)	Prohibited: accessing Marsh Island or White Banks Island from 15 February through 15 September to protect nesting birds (U.S. Fish and Wildlife Service, 2015d).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Cape Romain National Wildlife Refuge.
Cedar Keys National Wildlife Refuge (established in 1929; 3 km^2 in size)	Figure 6.1-2 (22)	Florida: Other AFTT Areas	Ecosystem (wilderness island areas; nesting and breeding ground for colonial birds, wading birds and shorebirds)	Prohibited: injuring, disturbing, or destroying any plant or animal Closed areas: interiors of all islands (except Atsena Otie Key). Seahorse Key and a 300 foot zone around the island is closed to all public entry from 1 March until 30 June (U.S. Fish and Wildlife Service, 2015c).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Cedar Keys National Wildlife Refuge.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	*Figure/ Reference Number*	*Location within the Study Area*	*Protection Focus*	*Summary of Relevant Regulations*	*Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations*
Chassahowitzka National Wildlife Refuge (established in 1943; 150 km^2 in size)	Figure 6.1-2 (23)	Florida: Other AFTT Areas	Ecosystem (estuarine habitat, waterfowl, West Indian manatees)	Restricted vessel speed in posted zones between 1 April and 31 August. Prohibited: firearms and weapons except during designated hunts (U.S. Fish and Wildlife Service, 2017b).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Chassahowitzka National Wildlife Refuge.
Great White Heron National Wildlife Refuge (established in 1938; 844 km^2 in size)	Figure 6.1-2 (24)	Florida: Other AFTT Areas, within 10 NM of Key West OPAREA and Key West Range Complex	Ecosystem (wading birds, coral reefs)	Prohibited: hunting or discharging firearms; feeding or harassing wildlife; landing airplanes, helicopters, or ultralights; personal watercraft, hovercrafts, or airboats (U.S. Fish and Wildlife Service, 2015b). Closed areas: most back country islands; public access is limited to some refuge managed and state-owned/refuge managed islands during daylight hours (U.S. Fish and Wildlife Service, 2017a).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within the Great White Heron National Wildlife Refuge.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	*Figure/ Reference Number*	*Location within the Study Area*	*Protection Focus*	*Summary of Relevant Regulations*	*Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations*
Key West National Wildlife Refuge (established in 1908; 856 km^2 in size)	Figure 6.1-2 (25)	Florida: Bordering Key West OPAREA and Key West Range Complex	Focal Resource (breeding grounds for native birds and other wildlife)	Prohibited: hunting or discharging firearms; feeding or harassing wildlife; landing airplanes, helicopters, or ultralights; personal watercraft, hovercrafts, or airboats Closed Areas: some beach sections on Boca Grande Key and Woman Key to protect sensitive plants and wildlife; all beach sections above mean high tide line (U.S. Fish and Wildlife Service, 2015a).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within the Key West National Wildlife Refuge.
Lower Suwannee National Wildlife Refuge (established in 1979; 341 km^2 in size)	Figure 6.1-2 (26)	Florida: Other AFTT Areas	Ecosystem (West Indian manatees, Gulf sturgeon [*Acipenser oxyrinchus desotoi*], shorebirds and wading birds)	Prohibited: collecting plants, animals, minerals, antlers, or artifacts; discharging firearms, except when in accordance with refuge hunting regulations (U.S. Fish and Wildlife Service, 2015h).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within the Lower Suwannee National Wildlife Refuge.
Merritt Island National Wildlife Refuge (established in 1963; 562 km^2 in size	Figure 6.1-2 (27)	Florida: Other AFTT Areas, 3 NM from JAX OPAREA	Focal Resource (habitat for migratory birds)	Prohibited: use of air thrust boats, hover craft, or personal watercraft; feeding, capturing, or harassing wildlife; picking or cutting vegetation (U.S. Fish and Wildlife Service, 2016f).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Merritt Island National Wildlife Refuge.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	*Figure/ Reference Number*	*Location within the Study Area*	*Protection Focus*	*Summary of Relevant Regulations*	*Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations*
National Key Deer Refuge (established in 1954; 561 km^2 in size)	Figure 6.1-2 (28)	Florida: Other AFTT Areas (within 10 NM of Key West OPAREA and Key West Range Complex)	Focal Resource (protect and preserve Key deer (*Odocoileus virginianus clavium*) and other wildlife resources in the Florida Keys)	Prohibited: feeding, capturing, or harassing wildlife; hunting or discharging firearms (U.S. Fish and Wildlife Service, 2015g).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within the National Key Deer Refuge.
St. Marks National Wildlife Refuge (established in 1931; 449 km^2 in size)	Figure 6.1-2 (29)	Florida: Other AFTT Areas	Ecosystem (shorebirds, marine mammals, American alligator [*Alligator mississippiensis*], sea turtles)	Prohibited: taking artifacts, natural features, animals, or plants; boats 16 October through 14 March, only non-motorized boats or boats with electric motors are allowed at other times (U.S. Fish and Wildlife Service, 2016e).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within St. Marks National Wildlife Refuge.
Ten Thousand Islands National Wildlife Refuge (established in 1996; 141 km^2 in size)	Figure 6.1-2 (30)	Florida: Other AFTT Areas	Ecosystem (birds, manatees, sea turtles, mangroves)	Prohibited: hunting, except duck hunting (U.S. Fish and Wildlife Service, 2016d).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within the Ten Thousand Islands National Wildlife Refuge.
Breton National Wildlife Refuge (established in 1904; 31 km^2 in size)	Figure 6.1-3 (31)	Louisiana: Other AFTT Areas	Ecosystem (nesting or wintering birds)	Prohibited: carrying, possessing, or discharging firearms; entry into the nesting areas and any disturbance of the nesting colonies (U.S. Fish and Wildlife Service, 2006a).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Breton National Wildlife Refuge.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	*Figure/ Reference Number*	*Location within the Study Area*	*Protection Focus*	*Summary of Relevant Regulations*	*Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations*
Delta National Wildlife Refuge (established in 1935; 206 km^2 in size)	Figure 6.1-3 (32)	Louisiana: Other AFTT Areas	Ecosystem (waterfowl, American alligator)	No area-specific regulations apply to Navy activities (U.S. Fish and Wildlife Service, 2014b).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within the Delta National Wildlife Refuge.
Shell Keys National Wildlife Refuge (established in 1907; 0.02 km^2 in size)	Figure 6.1-3 (33)	Louisiana: Other AFTT Areas	Ecosystem (nesting birds)	Prohibited: public access (U.S. Fish and Wildlife Service, 2008).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within the Shell Keys National Wildlife Refuge.
Sandy Point National Wildlife Refuge (established in 1984; 2 km^2 in size)	Figure 6.1-4 (34)	U.S. Virgin Islands: Other AFTT Areas	Ecosystem (sea turtles)	Prohibited: vehicles, horses, and dogs; power boats landing on the beach; boat anchors or anchor lines extending onto the beach (U.S. Fish and Wildlife Service, 2017c).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within the Sandy Point National Wildlife Refuge.
Gear Restricted Areas					
Lydonia Canyon Gear Restricted Area (established in 2009; 98 km^2 in size)	Figure 6.1-1 (35)	Massachusetts: Other AFTT Areas	Focal Resource (Tilefish [*Lopholatilus chamaeleonticeps*])	Fishing gear restrictions are not applicable to Navy; however, they are intended to prevent damage to bottom habitat (National Marine Fisheries Service, 2011).	Navy training and testing activities that release military expended materials are expected to occur in the vicinity of this area. This area is considered a Habitat Area of Particular Concern; all applicable analysis will be included in the Essential Fish Habitat Assessment.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	*Figure/ Reference Number*	*Location within the Study Area*	*Protection Focus*	*Summary of Relevant Regulations*	*Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations*
Oceanographer Canyon Gear Restricted Area (established in 2009; 205 km^2 in size)	Figure 6.1-1 (36)	Massachusetts: Other AFTT Areas	Focal Resource (Tilefish)	Fishing gear restrictions are not applicable to Navy; however, they are intended to prevent damage to bottom habitat (National Marine Fisheries Service, 2011).	Navy training and testing activities that release military expended materials are expected to occur in the vicinity of this area. This area is considered a Habitat Area of Particular Concern; all applicable analysis will be included in the Essential Fish Habitat Assessment.
Veatch Canyon Gear Restricted Area (established in 2009; 68 km^2 in size)	Figure 6.1-1 (37)	Massachusetts: Within W-105 of the Narragansett Bay OPAREA, Northeast Range Complexes	Focal Resource (Tilefish)	Fishing gear restrictions are not applicable to Navy; however, they are intended to prevent damage to bottom habitat (National Marine Fisheries Service, 2011).	Navy training and testing activities that release military expended materials are expected to occur in the vicinity of this area. This area is considered a Habitat Area of Particular Concern; all applicable analysis will be included in the Essential Fish Habitat Assessment.
Norfolk Canyon Gear Restricted Area (established in 2009; 85 km^2 in size)	Figure 6.1-1 (38)	Virginia: Overlaps W-386 of the VACAPES OPAREA (Surface Area Grid 8C)	Focal Resource (Tilefish)	Fishing gear restrictions are not applicable to Navy; however, they are intended to prevent damage to bottom habitat (National Marine Fisheries Service, 2011).	Navy training and testing activities that release military expended materials and/or include use of active sonar are expected to occur in the vicinity of this area. This area is considered a Habitat Area of Particular Concern; all applicable analysis will be included in the Essential Fish Habitat Assessment.
National Parks and Seashores					
Acadia National Park (established in 1919; 307 km^2 in size)	Figure 6.1-1 (39)	Maine: Other AFTT Areas, within 6.5 NM of Boston OPAREA	Ecosystem (natural and cultural heritage)	Prohibited: use of unmanned aircraft (National Park Service, 2017c).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural or cultural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Acadia National Park.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	*Figure/ Reference Number*	*Location within the Study Area*	*Protection Focus*	*Summary of Relevant Regulations*	*Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations*
Boston Harbor Islands National Recreation Area (established in 1996; 12 km^2 in size)	Figure 6.1-1 (40)	Massachusetts: Adjacent to the Boston OPAREA	Ecosystem (natural and cultural heritage)	No area-specific regulations apply to Navy activities (National Park Service, 2015a).	The resources protected by this area could be briefly exposed to aircraft overflights and small boat movement; however, overflights and small boat movement are not likely to harm the area's protected natural or cultural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Boston Harbor Islands National Recreation Area.
Cape Cod National Seashore (established in 1961; 164 km^2 in size)	Figure 6.1-1 (41)	Massachusetts: Adjacent to the Boston OPAREA	Ecosystem (marine, estuarine, fresh water and terrestrial habitats; breeding habitat for piping plover)	Prohibited: launching, landing, or operating an unmanned aircraft from or on lands and waters of the National Seashore; launching or recovering vessels, except in designated locations (National Park Service, 2016c).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Cape Cod National Seashore.
Fire Island National Seashore (established in 1964; 80 km^2 in size)	Figure 6.1-1 (42)	New York: Located within Naval Undersea Warfare Center Division Newport Testing Range	Ecosystem (nesting habitat for piping plover and roseate tern; population of seabeach amaranth [*Amaranthus pumilus*])	Prohibited: launching, landing, or operating an unmanned aircraft from or on lands and waters of the National Seashore (National Park Service, 2014a).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Fire Island National Seashore.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	Figure/ Reference Number	Location within the Study Area	Protection Focus	Summary of Relevant Regulations	Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations
Gateway National Recreational Area (established in 1972; 109 km^2 in size)	Figure 6.1-1 (43)	New York/New Jersey: Other AFTT Areas (Sandy Hook Bay, less than 2 NM from the pier of Naval Weapons Station Earle, New Jersey)	Ecosystem (nesting habitat for piping plover, shorebirds, and migratory birds; salt marshes)	Prohibited: landing vessels on ocean beaches between 15 March and Labor Day; vessel operations within Spermaceti Cove or within 46 m of marshes (36 CFR section 1.5) (National Park Service, 2011a). National Park Service Management Policies (2006) apply (36 CFR § 7.29) (National Park Service, 2006a).	The Navy would conduct homeland security and anti-terrorism/force protection training activities in the waters around the nearby Naval Weapons Station Earle, New Jersey; however, these proposed activities are not expected to occur in the marine protected area. The resources protected by this area could also be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. Therefore, no impacts are expected within Gateway National Recreational Area.
Assateague Island National Seashore (established in 1965; 198 km^2 in size)	Figure 6.1-1 (44)	Maryland/Virginia: Other AFTT Areas, within 3 NM of VACAPES OPAREA and W-386 of VACAPES Range Complex	Ecosystem (barrier island and aquatic habitats and species, natural coastal environment and processes)	Prohibited: personal watercraft beaching on the ocean side of the island unless in an emergency (36 CFR section 7.65) (National Park Service, 2011b).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Assateague Island National Seashore.
Colonial National Historical Park (established in 1930; 54 km^2 in size)	Figure 6.1-1 (45)	Virginia: Within 30 NM of VACAPES OPAREA, adjacent to York River	Ecosystem (natural and cultural heritage)	No area-specific regulations apply to Navy activities (National Park Service, 2017a).	The resources protected by this area could be briefly exposed to aircraft overflights and small boat movement; however, overflights and small boat movement are not likely to harm the area's protected natural or cultural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Colonial National Historic Park.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	***Figure/ Reference Number***	***Location within the Study Area***	***Protection Focus***	***Summary of Relevant Regulations***	***Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations***
Fort Monroe National Monument (established in 2011; 2 km^2 in size)	Figure 6.1-1 (46)	Virginia: Lower Chesapeake Bay, within 19 NM of VACAPES OPAREA	Ecosystem (natural and cultural heritage)	No area-specific regulations apply to Navy activities (National Park Service, 2016a).	The resources protected by this area could be briefly exposed to aircraft overflights and small boat movement; however, overflights and small boat movement are not likely to harm the area's protected natural or cultural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Fort Monroe National Monument.
Cape Hatteras National Seashore (established in 1937; 126 km^2 in size)	Figure 6.1-1 and Figure 6.1-2 (47)	North Carolina: Other AFTT Areas, 3 NM from VACAPES and Cherry Point OPAREAs	Ecosystem (barrier island habitat; nesting habitat for sea turtles and migratory birds; population of seabeach amaranth)	Prohibited: launching, landing, or operating an unmanned aircraft from or on lands and waters of the National Seashore (National Park Service, 2016b).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Cape Hatteras National Seashore.
Cape Lookout National Seashore (established in 1966; 113 km^2 in size)	Figure 6.1-1 and Figure 6.1-2 (48)	North Carolina: Other AFTT Areas, 3 NM from Cherry Point OPAREA	Ecosystem (barrier island and marsh habitats)	Prohibited: launching, landing, or operating an unmanned aircraft from or on lands and waters of the National Seashore; entry of vehicles into any area designated as a bird or turtle nesting area (National Park Service, 2015c).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Cape Lookout National Seashore.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	*Figure/ Reference Number*	*Location within the Study Area*	*Protection Focus*	*Summary of Relevant Regulations*	*Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations*
Fort Sumter National Monument (established in 1948; 1.3 km^2 in size)	Figure 6.1-2 (49)	South Carolina: Located within the Cooper River, within 5.5 NM of Charleston OPAREA	Ecosystem (natural and cultural heritage)	No area-specific regulations apply to Navy activities (National Park Service, 2017e).	The resources protected by this area could be briefly exposed to aircraft overflights and small boat movement; however, overflights and small boat movement are not likely to harm the area's protected natural or cultural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Fort Sumter National Monument.
Cumberland Island National Seashore (established in 2009; 68 km^2 in size)	Figure 6.1-2 (50)	Georgia: Other AFTT Areas	Ecosystem (barrier island and marsh habitats)	Prohibited: operating unmanned aircraft in the National Seashore (National Park Service, 2014c).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Cumberland Island National Seashore.
Fort Caroline National Memorial (established in 1953; 0.8 km^2 in size)	Figure 6.1-2 (51)	Florida: Adjacent to St. Johns River, within 8 NM of JAX OPAREA	Ecosystem (natural and cultural heritage)	No area-specific regulations apply to Navy activities (National Park Service, 2017d).	The resources protected by this area could be briefly exposed to aircraft overflights and small boat movement; however, overflights and small boat movement are not likely to harm the area's protected natural or cultural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Fort Carolina National Memorial.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	*Figure/ Reference Number*	*Location within the Study Area*	*Protection Focus*	*Summary of Relevant Regulations*	*Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations*
Biscayne National Park (established in 1968; 706 km^2 in size)	Figure 6.1-2 (52)	Florida: Other AFTT Areas, bordering South Florida Ocean Measurement Facility Testing Range	Ecosystem (corals, sea turtles, smalltooth sawfish [*Pristis pectinata*], West Indian manatee, American crocodile [*Crocodylus acutus*], least tern [*Sterna antillarum*], Johnson's seagrass [*Halophila johnsonii*])	State regulations and National Park Service Management Policies apply (National Park Service, 2006a). Lobster and sponge closed areas. Tropical fish are protected (National Park Service, 2006b).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Biscayne National Park.
Canaveral National Seashore (established in 1975; 237 km^2 in size)	Figure 6.1-2 (53)	Florida: Other AFTT Areas	Ecosystem (sea turtles)	Prohibited: vessels operating or anchoring within 500 feet of the mean low tide line on any part of the National Seashore (National Park Service, 2014b).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Canaveral National Seashore.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	Figure/ Reference Number	Location within the Study Area	Protection Focus	Summary of Relevant Regulations	Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations
Dry Tortugas National Park (established in 1935; 263 km^2 in size)	Figure 6.1-2 (54)	Florida: Entirely within W-174B of Key West Range Complex, 5 NM from Key West OPAREA	Ecosystem (corals)	Prohibited: anchoring outside of designated areas and times; operating a vessel in certain areas; discharging most materials; damaging or disturbing any living or dead organisms; allowing a vessel to strike or damage any immobile organism attached to the seabed; allowing a chain, rope, etc., to cause damage to coral, seagrasses, or submerged cultural resources. Closed areas apply (36 CFR section 7.27).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. Section 3.10.2.3.2 (Tortugas Military Operations Area) contains additional details regarding these activities. No other proposed activities are expected to occur in the area; therefore, no impacts are expected within the Dry Tortugas National Park.
Everglades National Park (established in 1934; 6,253 km^2 in size)	Figure 6.1-2 (55)	Florida: Other AFTT Areas	Ecosystem (subtropical wilderness, mangrove forest, wading birds, reptiles)	Prohibited: disturbance of aquatic life, except as allowable for fishing. Vessel closure areas and landing restrictions apply (36 CFR section 7.45).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within the Everglades National Park.
Gulf Islands National Seashore (established in 1971; 710 km^2 in size)	Figure 6.1-3 (56)	Florida: Adjacent to Panama City OPAREA	Ecosystem (natural and cultural heritage)	Prohibited: launching, landing, or operating an unmanned aircraft from or on lands and waters of the National Seashore (National Park Service, 2017b).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural or cultural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Gulf Islands National Seashore.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	Figure/ Reference Number	Location within the Study Area	Protection Focus	Summary of Relevant Regulations	Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations
Padre Island National Seashore (established in 1962; 533 km^2 in size)	Figure 6.1-3 (57)	Texas: Other AFTT Areas, 3 NM from Corpus Christi OPAREA	Ecosystem (barrier island habitat; nesting habitat for sea turtles and migratory birds)	Prohibited: launching, landing, or operating an unmanned aircraft from or on lands and waters of the National Seashore; launching hard hull motorized vessels from all beaches (National Park Service, 2016d).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Padre Island National Seashore.
Buck Island Reef National Monument (established in 1961; 77 km^2 in size)	Figure 6.1-4 (58)	U.S. Virgin Islands: Other AFTT Areas	Ecosystem (coral reefs, sea turtles, reef fishes)	No take of any resources is allowed. Prohibited: operating a watercraft in such a manner as to cause damage to any underwater feature; maneuvering watercraft within waters that contain marked swimming trails or interpretive signs; anchoring (36 CFR section 7.73).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Buck Island Reef National Monument.
Christiansted National Historic Site (established in 1952; 0.1 km^2 in size)	Figure 6.1-4 (59)	U.S. Virgin Islands: Other AFTT Areas	Ecosystem (natural and cultural heritage)	No area-specific regulations apply to Navy activities (National Park Service, 2015b).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural or cultural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within Christiansted National Historic Site.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	Figure/ Reference Number	Location within the Study Area	Protection Focus	Summary of Relevant Regulations	Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations
Salt River Bay National Historic Park and Ecological Preserve (established in 1992; 4 km^2 in size)	Figure 6.1-4 (60)	U.S. Virgin Islands: Other AFTT Areas	Ecosystem (mangrove forests, estuaries, coral reefs, submarine canyon)	Firearms may be legally possessed as provided under state, local, and federal regulations (National Park Service, 2010). National Park Service Management Policies apply (National Park Service, 2006a).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within the Salt River Bay National Historic Park and Ecological Preserve.
Virgin Islands Coral Reef National Monument (established in 2001; 52 km^2 in size)	Figure 6.1-4 (61)	U.S. Virgin Islands: Other AFTT Areas (partially overlaps the North Atlantic Gyre Open Ocean Area)	Ecosystem (coral reefs, seagrass beds, sea turtles, humpback whale [*Megaptera novaeangliae*] and many marine mammals, reef fishes)	No take of any resources is allowed. Prohibited: operating a watercraft in such a manner as to cause damage to any underwater feature; casting or dragging an anchor or other mooring device (36 CFR section 7.46).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within the Virgin Islands Coral Reef National Monument.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	*Figure/ Reference Number*	*Location within the Study Area*	*Protection Focus*	*Summary of Relevant Regulations*	*Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations*
Virgin Islands National Park (established in 1956; 60 km^2 in size)	Figure 6.1-4 (62)	U.S. Virgin Islands: Other AFTT Areas	Ecosystem (tropical coastal and marine ecosystem, including mangroves, corals, and tropical fishes)	Prohibited: operating a watercraft or casting or dragging an anchor or other mooring device in such a manner as to cause damage to any underwater feature; maneuvering watercraft within waters that contain marked swimming trails or interpretive signs. Prohibited: taking any form of marine life in Trunk Bay and in other waters containing underwater signs and markers (36 CFR section 7.74).	The resources protected by this area could be briefly exposed to aircraft overflights; however, overflights are not likely to harm the area's protected natural resources. No other proposed activities are expected to occur in the area. Therefore, no impacts are expected within the Virgin Islands National Park.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	*Figure/ Reference Number*	*Location within the Study Area*	*Protection Focus*	*Summary of Relevant Regulations*	*Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations*
National Marine Sanctuaries					
Gerry E. Studds Stellwagen Bank National Marine Sanctuary	Figure 6.1-5	Massachusetts: Bordering Boston OPAREA	Ecosystem (natural and cultural heritage)	See Section 6.1.2.6.1 for details.	Navy activities carried out in the sanctuary are conducted in accordance with sanctuary regulations; Navy will not conduct prohibited activities in the sanctuary, thus, is not required to obtain a permit. The Navy does not propose to conduct any new activities in the sanctuary that are likely to destroy, cause the loss of, or injure sanctuary resources or qualities. Since activities conducted near the sanctuary could potentially result in harassment takes to marine mammals when they are within the Sanctuary under the MMPA (defined as an injury to a sanctuary resource by the Office of National Marine Sanctuaries) the Navy consulted under Section 304(d) of the National Marine Sanctuaries Act. On 15 May 2018, in an injury determination letter in response to the Navy's sanctuary resource statement, the Office of National Marine Sanctuaries concluded that the Proposed Action is likely to cause injury to sanctuary resources, but given ongoing research and current Navy mitigations, no sanctuary-specific recommendations were issued under this consultation.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	***Figure/ Reference Number***	***Location within the Study Area***	***Protection Focus***	***Summary of Relevant Regulations***	***Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations***
Monitor National Marine Sanctuary	Figure 6.1-5	North Carolina: 20 NM from VACAPES OPAREA	Focal Resource (cultural heritage – shipwreck of the Civil War ironclad, USS Monitor)	See Section 6.1.2.6.2 for details.	Navy activities carried out in the sanctuary are conducted in accordance with sanctuary regulations; Navy will not conduct prohibited activities in the sanctuary, thus, is not required to obtain a permit. The Navy does not propose to conduct any new activities in the sanctuary that are likely to destroy, cause the loss of, or injure sanctuary resources or qualities. Since activities conducted outside the sanctuary would not potentially result in harassment takes under the MMPA (defined as an injury to a sanctuary resource by the Office of National Marine Sanctuaries) the Navy has not consulted under Section 304(d) of the National Marine Sanctuaries Act.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	*Figure/ Reference Number*	*Location within the Study Area*	*Protection Focus*	*Summary of Relevant Regulations*	*Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations*
Gray's Reef National Marine Sanctuary	Figure 6.1-6	Georgia: Entirely within Jacksonville OPAREA	Ecosystem (natural heritage – live bottom reef)	See Section 6.1.2.6.3 for details.	Navy activities carried out in the sanctuary are conducted in accordance with sanctuary regulations; Navy will not conduct prohibited activities in the sanctuary, thus, is not required to obtain a permit. The Navy does not propose to conduct any new activities in the sanctuary that are likely to destroy, cause the loss of, or injure sanctuary resources or qualities. Since activities conducted in and around the sanctuary could potentially result in harassment takes under the MMPA (defined as an injury to a sanctuary resource by the Office of National Marine Sanctuaries) the Navy consulted under Section 304(d) of the National Marine Sanctuaries Act. On 15 May 2018, in an injury determination letter in response to the Navy's sanctuary resource statement, the Office of National Marine Sanctuaries concluded that the Proposed Action is likely to cause injury to sanctuary resources, but given ongoing research and current Navy mitigations, no sanctuary-specific recommendations were issued under this consultation.

Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	*Figure/ Reference Number*	*Location within the Study Area*	*Protection Focus*	*Summary of Relevant Regulations*	*Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations*
Florida Keys National Marine Sanctuary	Figure 6.1-6	Florida: Bordering Key West OPAREA	Ecosystem (natural and cultural heritage: world's third largest barrier reef, shipwrecks)	See Section 6.1.2.6.4 for details.	Navy activities carried out in the sanctuary are conducted in accordance with sanctuary regulations; Navy will not conduct prohibited activities in the sanctuary, thus, is not required to obtain a permit. The Navy does not propose to conduct any new activities in the sanctuary that are likely to destroy, cause the loss of, or injure sanctuary resources or qualities. Since activities conducted in and around the sanctuary could potentially result in harassment takes under the MMPA (defined as an injury to a sanctuary resource by the Office of National Marine Sanctuaries) the Navy consulted under Section 304(d) of the National Marine Sanctuaries Act. On 15 May 2018, in an injury determination letter in response to the Navy's sanctuary resource statement, the Office of National Marine Sanctuaries recommended that the Navy continue to obtain updated data regarding sea turtle densities to support higher resolution modeling to further evaluate potential impacts to sea turtles from explosive stressors in Florida Keys National Marine Sanctuary.

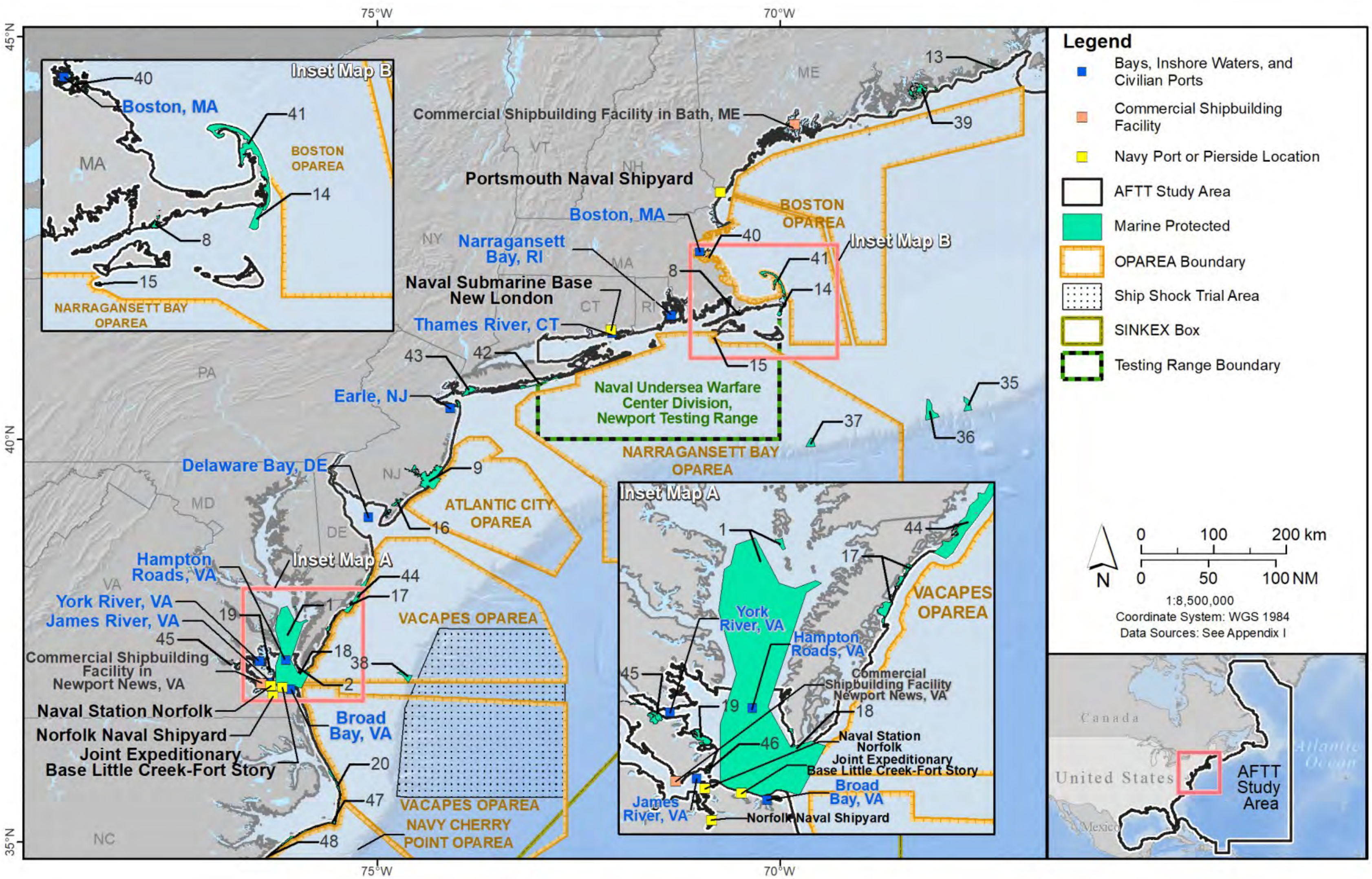
Table 6.1-2: National System of Parks and Marine Protected Areas within the Study Area (continued)

Marine Protected Area	*Figure/ Reference Number*	*Location within the Study Area*	*Protection Focus*	*Summary of Relevant Regulations*	*Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations*
Flower Garden Banks National Marine Sanctuary	Figure 6.1-6	Texas: 70 NM from Corpus Christi OPAREA	Ecosystem (natural and cultural heritage)	See Section 6.1.2.6.5 for details.	Navy activities carried out in the sanctuary are conducted in accordance with sanctuary regulations; Navy will not conduct prohibited activities in the sanctuary, thus, is not required to obtain a permit. The Navy does not propose to conduct any new activities in the sanctuary that are likely to destroy, cause the loss of, or injure sanctuary resources or qualities. Since activities conducted outside the sanctuary would not potentially result in harassment takes under the MMPA (defined as an injury to a sanctuary resource by the Office of National Marine Sanctuaries) the Navy has not consulted under Section 304(d) of the National Marine Sanctuaries Act.

Source*:* List of national system marine protected areas in the Study Area and their protection focuses (National Marine Protected Areas Center, 2013)

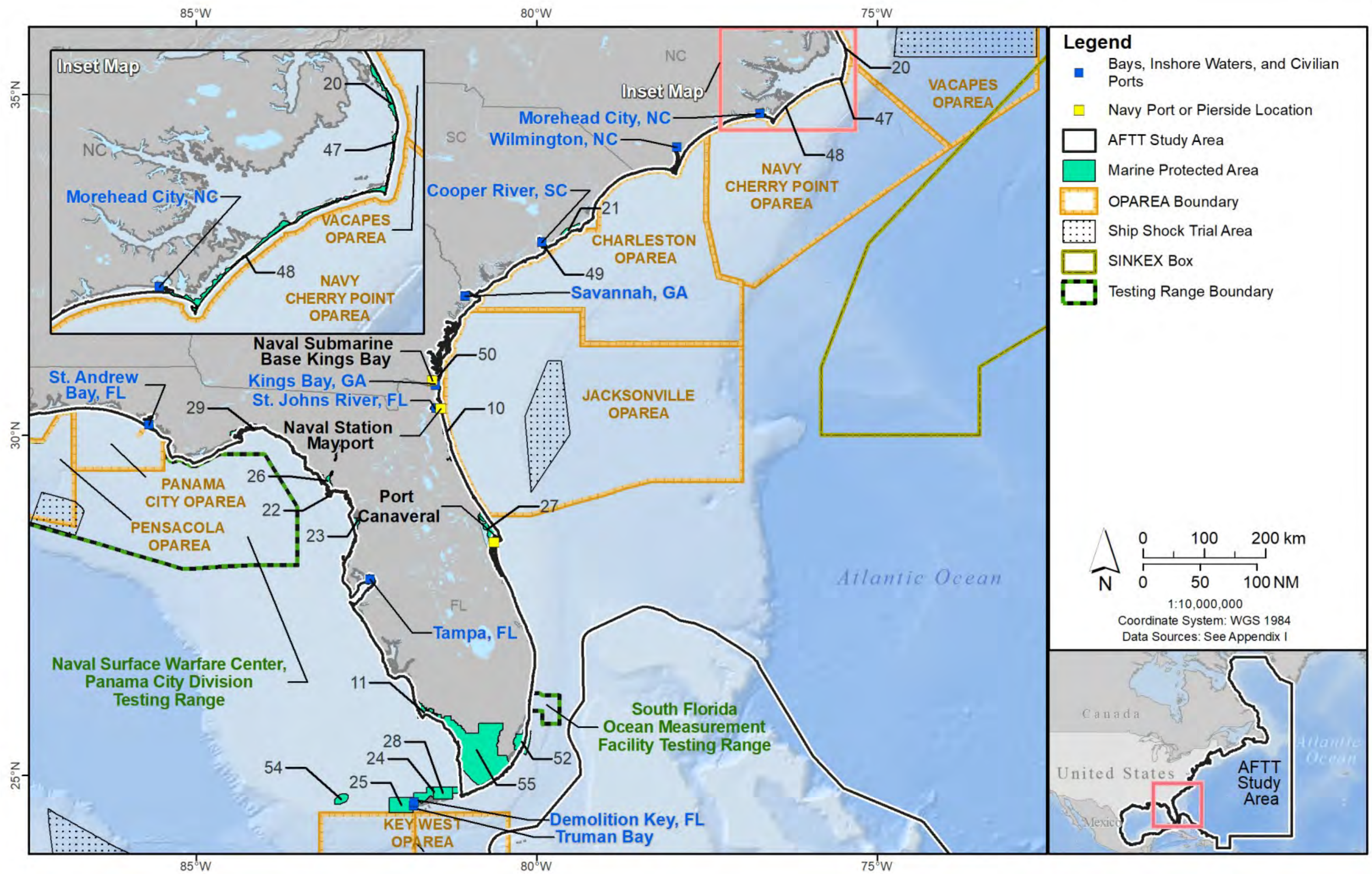
Notes: Other AFTT Areas include areas outside of range complexes and testing ranges but still within the AFTT Study Area. Other AFTT Area events typically refer to those events that occur while vessels are in transit.

AFTT: Atlantic Fleet Training and Testing; JAX: Jacksonville; OPAREA: Operating Area; VACAPES: Virginia Capes.



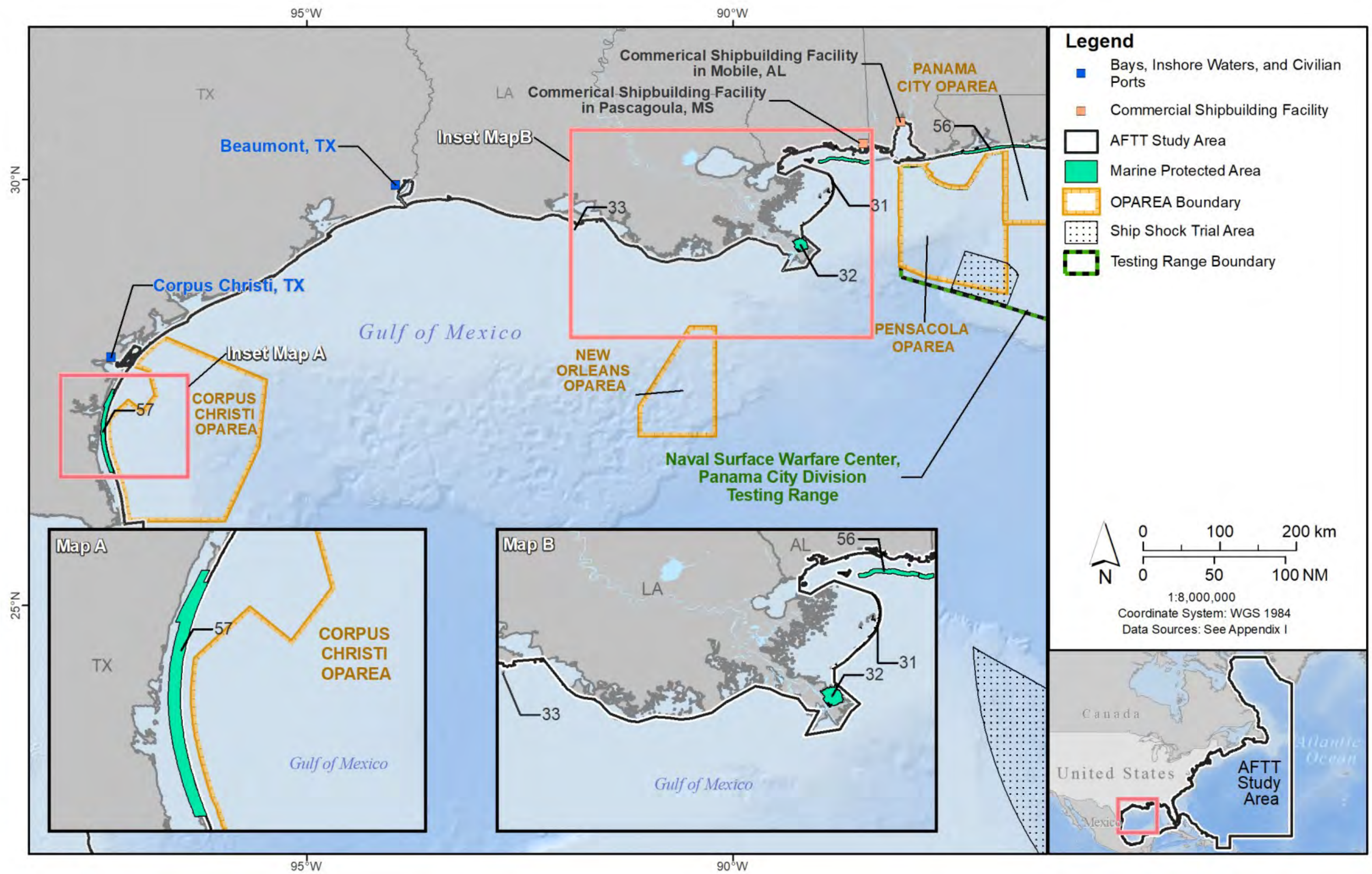
Notes: AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area; SINKEX: Sinking Exercise; VACAPES: Virginia Capes

Figure 6.1-1: Location of National System of Marine Protected Areas within the Northeast and Mid-Atlantic Portion of the Study Area



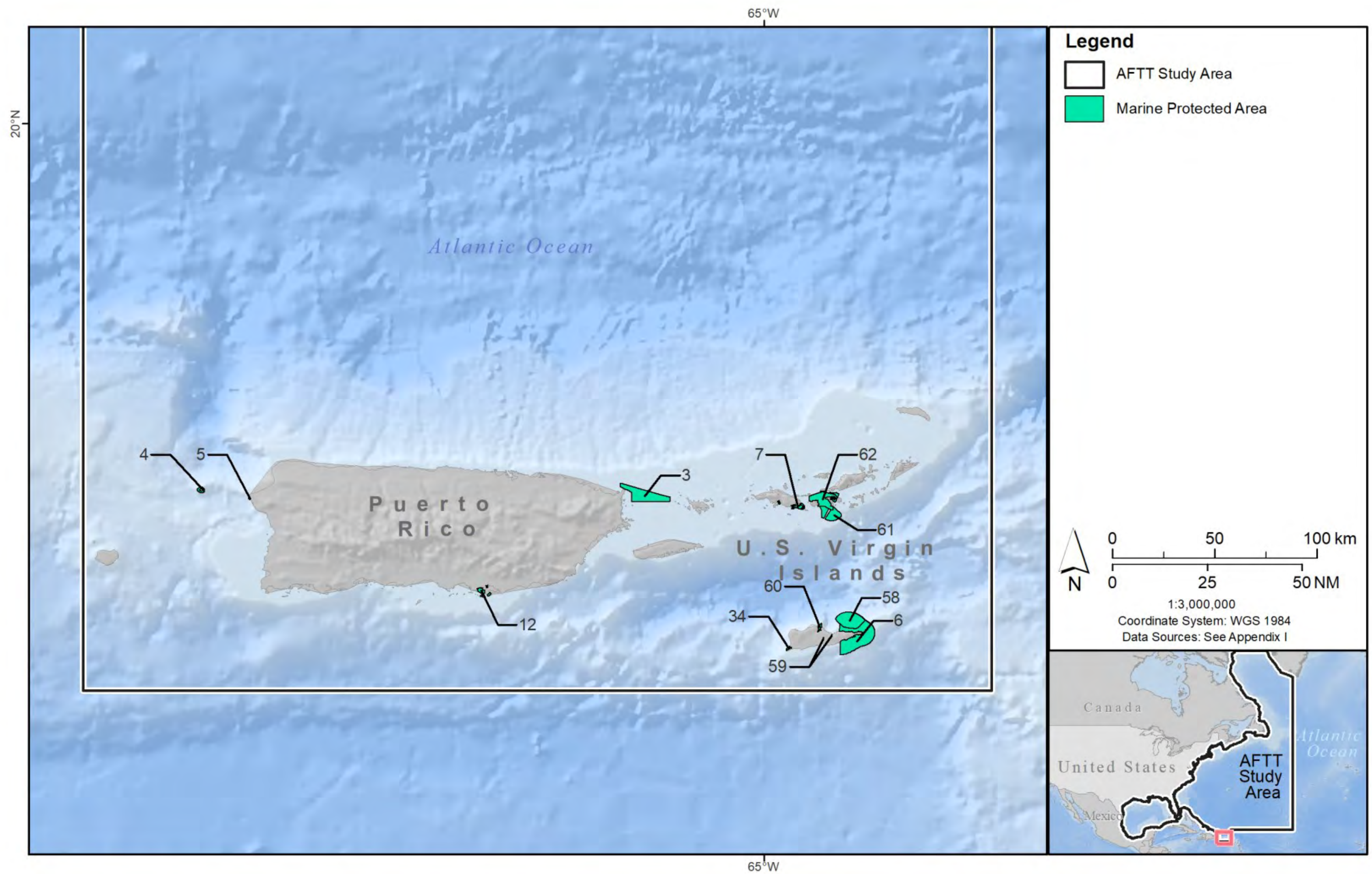
Notes: AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area; SINKEX: Sinking Exercise; VACAPES: Virginia Capes

Figure 6.1-2: Location of National System of Marine Protected Areas within the Southeast Atlantic Portion of the Study Area



Notes: AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area

Figure 6.1-3: Location of National System of Marine Protected Areas within the Gulf of Mexico Portion of the Study Area



Notes: AFTT: Atlantic Fleet Training and Testing

Figure 6.1-4: Location of National System of Marine Protected Areas within the Caribbean Portion of the Study Area

6.1.2.1 State Marine Protected Areas

State governments have established marine protected areas, including state parks and species-specific sanctuaries, for the management of fisheries, nursery grounds, shellfish beds, recreation, tourism, and other uses. These areas have a diverse array of conservation objectives, from protecting ecological functions, to preserving shipwrecks, to maintaining traditional or cultural interaction with the marine environment. There are two state marine protected areas and five territorial marine protected areas in the Study Area (see Table 6.1-2 and Figure 6.1-1 through Figure 6.1-4).

6.1.2.2 National Estuarine Research Reserves

National Estuarine Research Reserve System sites protect estuarine land and water and provide habitat for wildlife. These sites also provide educational opportunities for students, teachers, and the public and serve as laboratories for scientists (15 CFR Part 921). The National Estuarine Research Reserve Program was established through the Coastal Zone Management Act and is administered in coordination with the National Marine Sanctuary System. Each reserve is managed by a state agency or university with input from local partners on a site-specific basis. There are five National Estuarine Research Reserves in the Study Area that are included in the National System of marine protected (see Table 6.1-2 and Figure 6.1-1 through Figure 6.1-4).

6.1.2.3 National Wildlife Refuges

National Wildlife Refuges are managed by the USFWS in accordance with Executive Order 12996, *Management and General Public Use of the National Wildlife Refuge System*, the National Wildlife Refuge System Administration Act of 1966, and the National Wildlife Refuge System Improvement Act of 1997. The National Wildlife Refuge System serves as a national network of lands and waters for the conservation, management, and where appropriate, restoration of fish, wildlife, and plant resources and habitats. National wildlife refuges are managed on a site-specific basis. Activities conducted within a refuge must not impair existing wildlife-dependent recreational uses or reduce the potential of the refuge to provide quality, compatible, wildlife-dependent recreation into the future. The USFWS is directed to continue, consistent with existing laws and interagency agreements, authorized or permitted refuge uses necessary to facilitate military preparedness; however, new agreements permitting military preparedness activities on refuges are discouraged (U.S. Fish and Wildlife Service, 2006b). There are 22 National Wildlife Refuges in the Study Area (see Table 6.1-2 and Figure 6.1-1 through Figure 6.1-4).

6.1.2.4 Gear Restricted Areas

The NMFS is responsible for overseeing Regional Fishery Management Councils that are established under the Magnuson-Stevens Act. These councils are used to create and implement Fishery Management Plans, which help conserve and manage important fisheries in the United States (50 CFR Chapter 6). One management strategy used is the creation of Gear Restricted Areas, some of which are included in the National System of marine protected areas. There are four Gear Restricted Areas in the Study Area (see Table 6.1-2 and Figure 6.1-1 through Figure 6.1-4).

6.1.2.5 National Parks and Seashores

The National Park Service administers all National Parks, National Seashores, and some of the National Recreation Areas and National Monuments to conserve the scenery and the natural and historic objects and wildlife contained within. Park managers control all park usage to ensure that park resources and values are preserved for the future; they must always seek ways to avoid, or to minimize to the greatest extent practicable, adverse impacts on park resources and values. In general, military activities are discouraged in parks; the use of weaponry is not allowed, and unacceptable impacts from aircraft overflights (e.g., flights that unreasonably interfere with the atmosphere of peace and tranquility, or the natural soundscape maintained within the park) should be avoided. Unacceptable impacts are those that fall short of impairment but are still not acceptable within a particular park's environment, as determined by the professional judgment of the park manager in accordance with *National Park Service Management Policies 2006* (National Park Service, 2006a). Military services may request the use of park areas for noncombat exercises. Permits are approved at the discretion of the park superintendent. There are nine National Seashores, two Marine National Monuments, five National Parks, two National Monuments, two National Recreation Areas, two National Historic Parks, one National Historic Memorial, one National Historic Site, and one National Historic Park and Ecological Preserve in the Study Area (see Table 6.1-2 and Figure 6.1-1 through Figure 6.1-4).

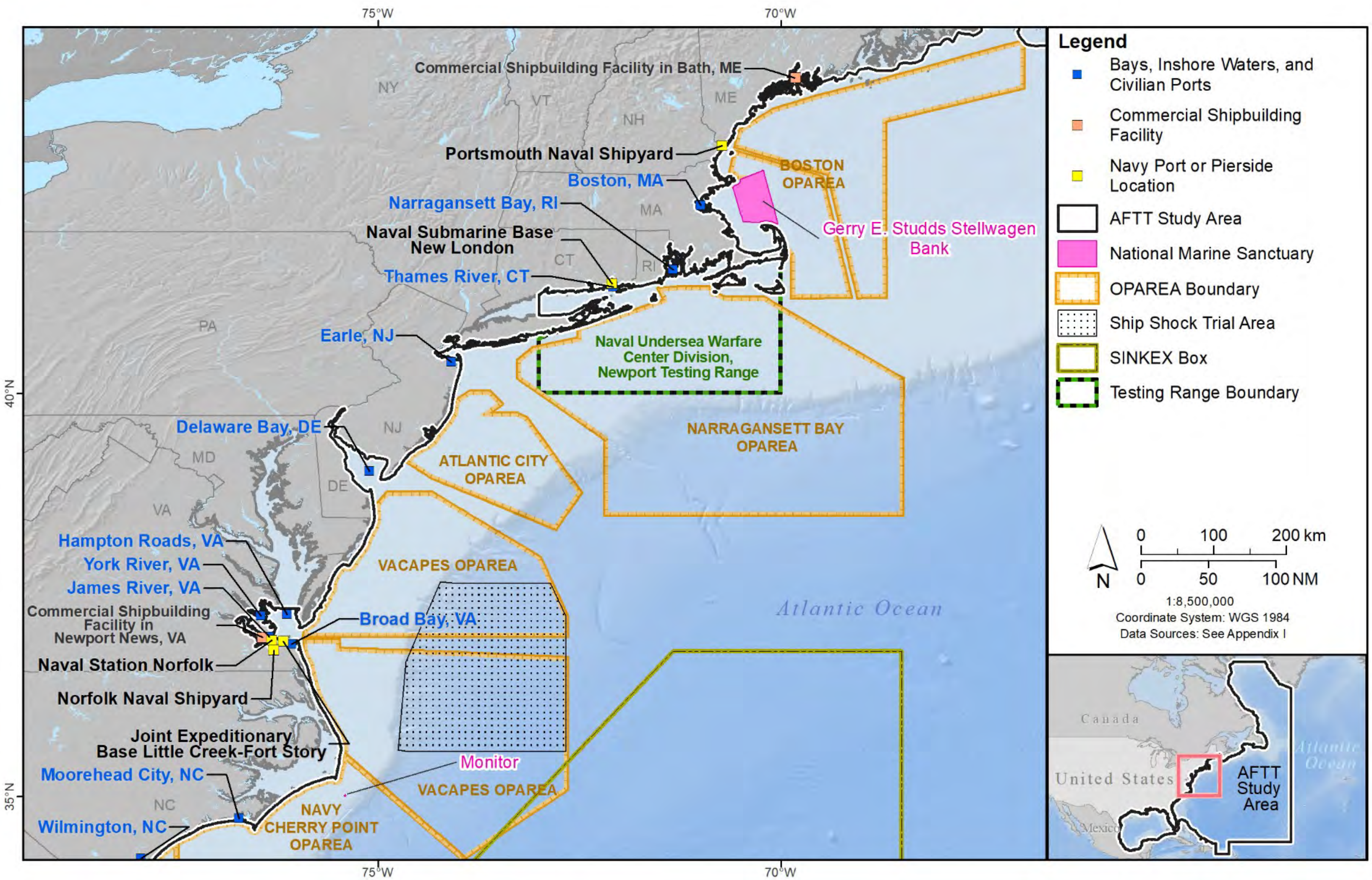
6.1.2.6 National Marine Sanctuaries

Under the Marine Protection, Research, and Sanctuaries Act of 1972 (also known as the National Marine Sanctuaries Act), the National Oceanic and Atmospheric Administration establishes a national marine sanctuary for marine areas with special conservation, recreational, ecological, historical, cultural, archaeological, scientific, educational, or aesthetic qualities. The National Marine Sanctuaries Act and federal regulations prohibit destroying, causing the loss of, or injuring any sanctuary resource managed under the law or regulations for that sanctuary (16 U.S.C. section 1436(a); 15 CFR Part 922). National Marine Sanctuaries are managed on a site-specific basis, and each sanctuary has site-specific regulatory prohibitions. Each sanctuary also has site-specific regulatory exemptions from the prohibitions for certain military activities.

Additionally, section 304(d) of the National Marine Sanctuaries Act requires federal agencies to consult with the Office of National Marine Sanctuaries whenever their proposed actions are likely to destroy, cause the loss of, or injure a sanctuary resource. Within the Study Area, there are five National Marine Sanctuaries included in the List of National System Marine Protected Areas. The National Marine Sanctuaries within the Study Area are mapped in Figure 6.1-5 and Figure 6.1-6. The sanctuaries are described in additional detail below, along with a summary of the potential environmental impacts of the proposed training and testing activities anticipated to occur within or within the vicinity of each sanctuary. Where appropriate, the Navy has prepared a Sanctuary Resources Statement describing its proposed actions and potential effects on sanctuary resources, which has been submitted to the Office of National Marine Sanctuaries to initiate National Marine Sanctuaries Act section 304(d) consultation.

6.1.2.6.1 Gerry E. Studds Stellwagen Bank National Marine Sanctuary

The Gerry E. Studds Stellwagen Bank National Marine Sanctuary is located within the Northeast U.S. Continental Shelf Large Marine Ecosystem in the eastern portion of Massachusetts Bay between Cape Ann and Cape Cod and the southwest corner of the Gulf of Maine (Figure 6.1-5). The sanctuary includes an area of nearly 638 square nautical miles (NM^2) and was designated in 1992 to preserve the area's natural and historic resources, including nearly 50 shipwrecks (National Oceanic and Atmospheric Administration, 2010). Stellwagen Bank provides habitat for invertebrates, sea turtles including the leatherback and Kemp's ridley, and 17 species of cetaceans (National Marine Sanctuary Program, 2007b). The area supports important feeding grounds for the fin, humpback, sei, and North Atlantic right whale. A diversity of seabird species dominated by loons, fulmars, shearwaters, storm petrels, cormorants, phalaropes, alcids, gulls, jaegers, and terns use the area for foraging (National Oceanic and Atmospheric Administration, 2010). Human uses of the Gerry E. Studds Stellwagen Bank National Marine Sanctuary include commercial shipping, recreational fishing, whale watching, and scuba diving.



Notes: AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area; SINEX: Sinking Exercise; VACAPES: Virginia Capes

Figure 6.1-5: Location of National Marine Sanctuaries within the Northeast and Mid-Atlantic Portion of the Study Area

Regulations for the Gerry E. Studds Stellwagen Bank National Marine Sanctuary prohibit the following (15 CFR section 922.142(a)):

(1) (i) Discharging or depositing, from within the boundary of the sanctuary, any material or other matter except:

(A) Fish, fish parts, chumming materials or bait used in or resulting from traditional fishing operations in the sanctuary;
(B) Biodegradable effluent incidental to vessel use and generated by marine sanitation devices approved in accordance with Section 312 of the Federal Water Pollution Control Act, as amended, 33 U.S.C. 1322 et seq.;
(C) Water generated by routine vessel operations (e.g., cooling water, deck wash down and graywater as defined by Section 312 of the Federal Water Pollution Control Act) excluding oily wastes from bilge pumping; or
(D) Engine exhaust.

(ii) Discharging or depositing, from beyond the boundary of the sanctuary, any material or other matter, except those listed in paragraphs (a)(1)(i) (A) through (D) of this section, that subsequently enters the sanctuary and injures a sanctuary resource or quality.

(2) Exploring for, developing or producing industrial materials within the sanctuary.
(3) Drilling into, dredging or otherwise altering the seabed of the sanctuary; or constructing, placing or abandoning any structure, material or other matter on the seabed of the sanctuary, except as an incidental result of:

(i) Anchoring vessels;
(ii) Traditional fishing operations; or
(iii) Installation of navigation aids.

(4) Moving, removing or injuring, or attempting to move, remove or injure, a sanctuary historical resource. This prohibition does not apply to moving, removing or injury resulting incidentally from traditional fishing operations.
(5) Taking any marine reptile, marine mammal or seabird in or above the sanctuary, except as permitted by the Marine Mammal Protection Act, as amended, (MMPA), 16 U.S.C. 1361 et seq., the Endangered Species Act, as amended, (ESA), 16 U.S.C. 1531 et seq., and the Migratory Bird Treaty Act, as amended, (MBTA), 16 U.S.C. 703 et seq.
(6) Lightering [cargo transfer between vessels] in the sanctuary.
(7) Possessing within the sanctuary (regardless of where taken, moved or removed from), except as necessary for valid law enforcement purposes, any historical resource, or any marine mammal, marine reptile or seabird taken in violation of the MMPA, ESA or MBTA.
(8) Interfering with, obstructing, delaying or preventing an investigation, search, seizure or disposition of seized property in connection with enforcement of the Act or any regulation or permit issued under the Act.

The Stellwagen Bank National Marine Sanctuary regulations state that all Department of Defense (DoD) military activities are to be carried out in a manner that avoids to the maximum extent practicable any adverse impacts on sanctuary resources and qualities (15 CFR section 922.142(c)(1)(i)). Activities carried out by the DoD may be exempted from sanctuary prohibitions after consultation with the Office of National Marine Sanctuaries (15 CFR section 922.142(c)(1)(ii)).

The Gerry E. Studds Stellwagen Bank National Marine Sanctuary Management Plan and Environmental Assessment was released in June 2010 (National Oceanic and Atmospheric Administration, 2010) and considered Navy activities at the time of the document. Specifically, the document stated that the Navy rarely conducts activities within the Sanctuary. This is due to the shallow depths within the boundaries of the Sanctuary which are unsuitable for submarine operations as well as crowded waters which make warfare training exercises difficult to execute. Naval ships transit the Sanctuary several times a year primarily to access the Port of Boston. During these transits, the ships follow standard operating procedures that direct the posting of a Lookout for whales and avoiding discharges in the Sanctuary. Some training and testing activities in deep waters (greater than 200 meters) beyond the Sanctuary may have the potential to acoustically disturb some Sanctuary resources. This information is still accurate today. Additionally, the Navy uses a software program (Protective Measures Assessment Protocol) to determine which mitigation measures are necessary when training and testing in and around the Sanctuary.

The Navy considered all proposed training and testing activities that could occur within the Stellwagen Bank National Marine Sanctuary and identified that the proposed activities could fall into the following categories:

1. The following platforms, sources, or items that are part of Navy activities may be used within the Gerry E. Studds Stellwagen Bank National Marine Sanctuary, because they (1) are not prohibited under the sanctuary regulations, and (2) are carried out in a manner that avoids to the maximum extent practicable any adverse impacts on sanctuary resources and qualities (15 CFR section 922.142(c)(1)(i)):

   - <u>Aircraft and Aerial Targets</u>

   Aircraft and aerial targets are expected to cause only a minor and temporary behavioral reaction due to noise for marine mammals (reactions do not rise to the level of take under the MMPA), sea turtles, or fishes that may be present in the area. In addition to possible minor behavioral reactions due to noise, there is slight potential for seabirds to be struck by aircraft or aerial targets. As discussed in Section 2.3.3 (Standard Operating Procedures), the Navy implements standard operating procedures for aircraft safety that will reduce the potential for aircraft strikes. Targets are not expendable and will not be discharged into the waters of the Sanctuary. For a more detailed discussion of potential impacts to these resources from the use of aircraft and aerial targets, see the following sections:

   Section 3.6.3.4.2 (Impacts from Aircraft and Aerial Targets) for fishes
   Section 3.7.3.4.2 (Impacts from Aircraft and Aerial Targets) for marine mammals
   Section 3.8.3.4.2 (Impacts from Aircraft and Aerial Targets) for reptiles
   Section 3.9.3.4.2 (Impacts from Aircraft and Aerial Targets) for birds, which includes discussion of applicable seabirds

   - <u>Vessels and in-water devices (that do not make contact with seafloor)</u>

   Noise from vessels and in-water devices (excluding sonar and other active acoustic sources) is expected to cause only a minor and temporary behavioral reaction for marine mammals (reactions do not rise to the level of take under the MMPA), sea turtles, seabirds, or fishes that may be present in the area. There is potential for marine mammals, sea turtles, seabirds, floating vegetation, invertebrates, and large slow-moving fish species, to be struck by or to collide with vessels. As discussed in section 2.3.3 (Standard Operating Procedures), the Navy implements standard operating procedures for vessel and towed in-water device safety that will reduce the marine mammal strike potential. As discussed in Section 5.3.4 (Physical Disturbance and Strike Stressors), the Navy will implement mitigation to further reduce the potential for marine mammal strikes by vessels and in-water devices. For a more detailed discussion of potential impacts to these resources from the use of vessels and in-water devices, see the following sections:

Section 3.3.3.4.1 (Impacts from Vessels and In-Water Devices) for vegetation
Section 3.4.3.4.1 (Impacts from Vessels and In-Water Devices) for invertebrates
Section 3.6.3.4.1 (Impacts from Vessels and In-Water Devices) for fishes
Section 3.7.3.4.1 (Impacts from Vessels and In-Water Devices) for marine mammals
Section 3.8.3.4.1 (Impacts from Vessels and In-Water Devices) for reptiles
Section 3.9.3.4.1 (Impacts from Vessels and In-Water Devices) for birds

2. The following platforms, sources, or items that are part of Navy activities, but are not planned to be used within the Gerry E. Studds Stellwagen Bank National Marine Sanctuary (including a 2.7 NM buffer) as part of the Proposed Action:

- Sonar and other active acoustic sources
- Explosives detonated in-air, at the surface, or underwater
- Military expended materials
- Seafloor devices

The Navy's Proposed Action is consistent with the activities that were occurring when the Stellwagen Bank National Marine Sanctuary was designated, as well as during the development of the 2010 Management Plan. Navy activities carried out in the Sanctuary are conducted in a manner that avoids to the maximum extent practicable any adverse impacts on sanctuary resources and qualities. The Navy does not propose to conduct any new activities in the Sanctuary that may affect sanctuary resources or qualities of those resources. Further, the Navy does not propose to increase the level of existing activities within the Sanctuary from what was previously considered at the time of sanctuary designation. Since activities conducted near the sanctuary could potentially result in harassment takes under the MMPA to marine mammals when they are within the Sanctuary (defined as an injury to a sanctuary resource by the Office of National Marine Sanctuaries) the Navy consulted under Section 304(d) of the National Marine Sanctuaries Act. On 15 May 2018, in an injury determination letter in response to the Navy's sanctuary resource statement, the Office of National Marine Sanctuaries concluded that the Proposed Action is likely to cause injury to sanctuary resources, but given ongoing research and current Navy mitigations, no sanctuary-specific recommendations were issued under this consultation.

6.1.2.6.2 *Monitor* National Marine Sanctuary

The *Monitor* National Marine Sanctuary is located within the Southeast U.S. Continental Shelf Large Marine Ecosystem off the coast of Cape Hatteras, North Carolina (Figure 6.1-5). The geographical extent of the sanctuary is defined by the shipwreck and its surrounding 1 NM diameter area. The Sanctuary includes the column of water extending from the ocean surface to the seabed. The sanctuary was established in 1975 to preserve the historical and cultural artifacts of the USS *Monitor* shipwreck, the nation's first ironclad warship. The *Monitor* serves as a valuable national heritage and naval cultural specimen (Office of National Marine Sanctuaries, 2013).

Regulations for the *Monitor* National Marine Sanctuary prohibit the following (15 CFR 922.61):

(a) Anchoring in any manner, stopping, remaining, or drifting without power at any time;
(b) Any type of subsurface salvage or recovery operation;
(c) Diving of any type, whether by an individual or by a submersible;
(d) Lowering below the surface of the water any grappling, suction, conveyor, dredging or wrecking device;
(e) Detonating below the surface of the water any explosive or explosive mechanism;
(f) Drilling or coring the seabed;
(g) Lowering, laying, positioning or raising any type of seabed cable or cable-laying device;
(h) Trawling; or
(i) Discharging waste material into the water in violation of any Federal statute or regulation.

Free passage through the Sanctuary is not a prohibited activity under the Sanctuary regulations, and therefore, is permissible. The *Monitor* National Marine Sanctuary does not have specific military exemptions from the applicable Office of National Marine Sanctuaries Regulations (15 CFR sections 922.60–62).

The *Monitor* National Marine Sanctuary Final Management Plan and Environmental Assessment was released in February 2013 (Office of National Marine Sanctuaries, 2013).

To ensure compliance with the Office of National Marine Sanctuaries Regulations, the Navy considered all proposed training and testing activities that could occur within the sanctuary. All activities would be conducted in a manner that avoids to the maximum extent practicable any adverse impacts on sanctuary resources. The Navy concluded that the proposed activities could fall into the following two categories:

1. The following platforms, sources, or items that are part of Navy activities may be used within the Monitor National Marine Sanctuary because they are not prohibited under the sanctuary regulations:

   - <u>Aircraft and Aerial Targets</u>

   Aircraft and aerial targets would have no impact on the *Monitor* shipwreck, as all targets are recovered and will not reach the ocean floor.

   - <u>Vessels and in-water devices (that do not make contact with seafloor)</u>

   The *Monitor* National Marine Sanctuary allows transit of vessels through the sanctuary. Furthermore, vessels and in-water devices would have no impact on the *Monitor* shipwreck.

   - <u>Sonar and other active acoustic sources</u>

   Sonar and other active acoustic sources would have no impact on the *Monitor* shipwreck.

   - <u>Electromagnetic devices</u>

Electromagnetic devices would have no impact on the *Monitor* shipwreck.

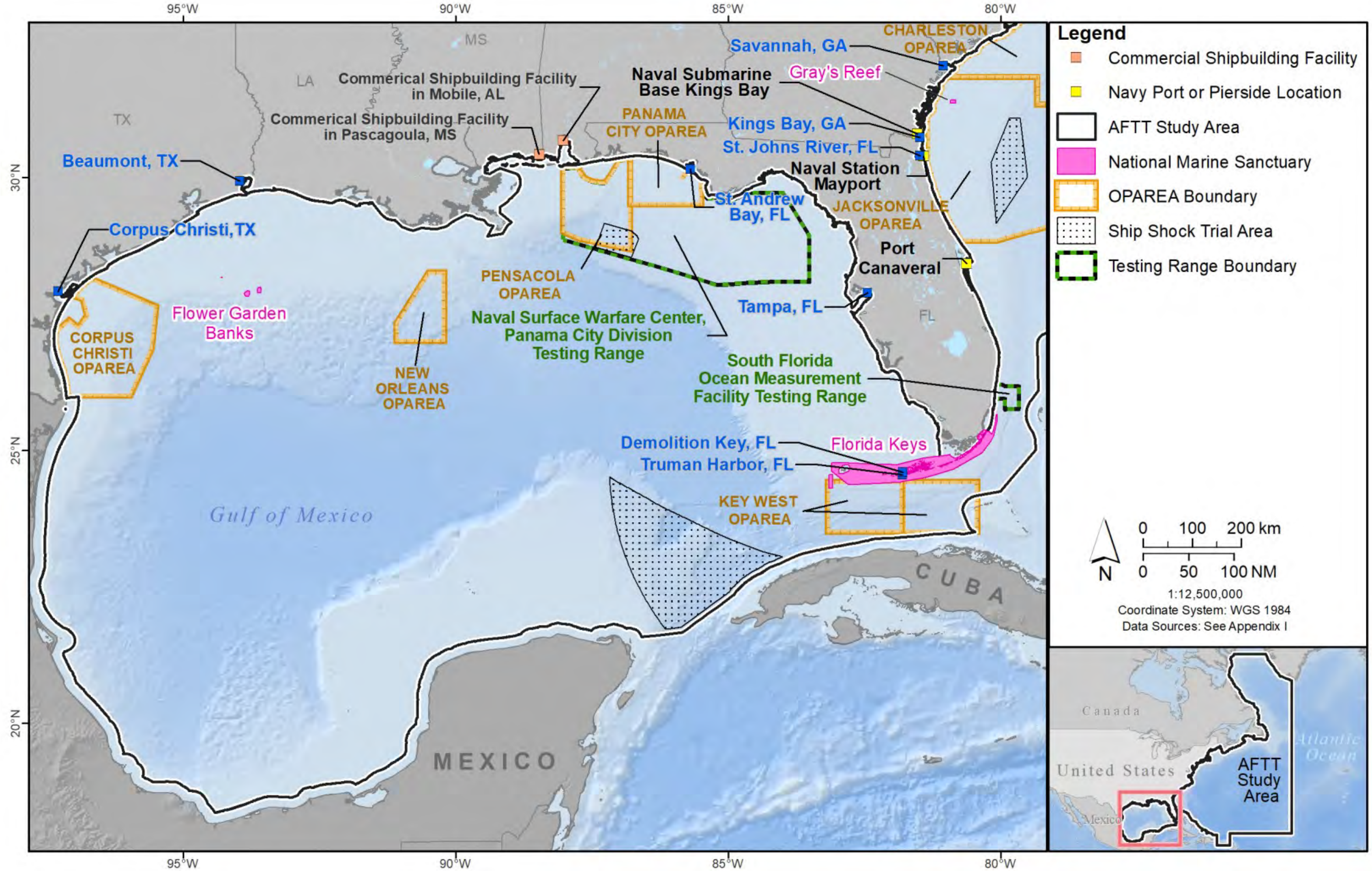
2. The following platforms, sources, or items that are part of Navy activities, but are not planned to be used within *Monitor* National Marine Sanctuary (including a 2.7 NM buffer) as part of the Proposed Action:

- Explosives detonated in-air, at the surface, or underwater
- Military expended materials
- Seafloor devices

The Navy does not propose to conduct any new activities that would cause significant impacts on sanctuary resources. Furthermore, the Navy does not propose to increase the level of existing activities within the Monitor National Marine Sanctuary from what was previously considered at the time of sanctuary designation. Since none of the Navy's training and testing activities proposed to be conducted within or in the vicinity of Monitor National Marine Sanctuary are likely to injure sanctuary resources, the Navy has determined that it is not required to engage in section 304(d) consultation under the National Marine Sanctuaries Act.

6.1.2.6.3 Gray's Reef National Marine Sanctuary

The Gray's Reef National Marine Sanctuary is located within the Southeast U.S. Continental Shelf Large Marine Ecosystem 16.5 NM off Sapelo Island, Georgia (Figure 6.1-6). The sanctuary includes an area of approximately 17 NM^2 and was designated in 1981 to preserve the area's open ocean and live bottom habitat. Gray's Reef National Marine Sanctuary is the only marine protected area in the region that focuses on protection and conservation of all natural marine resources (National Marine Sanctuary Program, 2006). Gray's Reef supports an unusual assemblage of temperate and tropical species. A series of rock ledges and sand expanses have created deep burrows, troughs, and caves that support bottom-dwelling plants and animals, such as sponges, barnacles, sea fans, hard coral, crabs, lobsters, and snails. The diverse topography provides habitat for a diverse fish community, with an estimated 200 species, including black sea bass (*Centropristis striata*), snapper (*Lutjanidae* spp.), grouper (*Epinephelinae* spp.), and mackerel (*Scombridae* spp.). Gray's Reef is an important area for resting and foraging for both adult and juvenile loggerhead sea turtles throughout the year. Atlantic spotted dolphins and bottlenose dolphins are the most common marine mammals at the sanctuary; however, the highly endangered North Atlantic right whale has been observed during winter migration and calving season. Pelagic birds observed at Gray's reef include gulls, petrels, shearwaters, Northern Gannet, phalaropes, jaegers, and terns (National Marine Sanctuary Program, 2006).



Notes: AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area

Figure 6.1-6: Location of National Marine Sanctuaries within the Southeast Atlantic and Gulf of Mexico Portion of the Study Area

Numerous cover types are found on the sanctuary's ledges, including macroalgae, sponges, tunicates, coral, and gorgonians; sessile invertebrates are the most diverse and abundant components, while corals are less common and form smaller colonies than in tropical regions (Bauer et al., 2008). The primary coral species in Gray's Reef National Marine Sanctuary is the branching coral *Oculina arbuscula*—present on 75 percent of ledge sites, but contributing to a small percentage of overall cover. Sessile benthic organisms are susceptible to both direct and indirect damage from marine debris, ranging from abrasion by lines and wires, to entanglement (particularly *Oculina* sp.), to algal fouling and eventual coral death (Bauer et al., 2008).

General regulations for the Gray's Reef National Marine Sanctuary prohibit the following (15 CFR section 922.92(a)):

(1) Dredging, drilling into, or otherwise altering in any way the submerged lands of the sanctuary (including bottom formations).

(2) Constructing any structure other than a navigation aid, or constructing, placing, or abandoning any structure, material, or other matter on the submerged lands of the Sanctuary except weighted marker buoys that are continuously tended and used during otherwise lawful fishing or diving activities and that are not attached to a vessel and not capable of holding a boat at anchor. Weights used with a marker buoy shall not have a combined weight of more than 10 pounds, shall be attached with not greater than one-fourth inch (1/4") line and shall be removed from the Sanctuary within twelve (12) hours of deployment. Any weighted marker buoy that is not continuously tended may be removed by the Assistant Administrator or designee or an authorized officer, without notice.

(3) Discharging or depositing any material or other matter except:

- (i) Fish or fish parts, bait, or chumming materials;
- (ii) Effluent from marine sanitation devices; and
- (iii) Vessel cooling water.

(4) Operating a watercraft other than in accordance with the Federal rules and regulations that would apply if there were no sanctuary.

(5) (i) Injuring, catching, harvesting, or collecting, or attempting to injure, catch, harvest, or collect, any marine organism, or any part thereof, living or dead, within the sanctuary by any means except by use of rod and reel, and handline gear;

- (ii) There shall be a rebuttable presumption that any marine organism or part thereof referenced in this paragraph found in the possession of a person within the sanctuary has been collected from the sanctuary.

(6) Using any fishing gear within the sanctuary except rod and reel, and handline gear, or for law enforcement purposes.

(7) Using underwater any explosives, or devices that produce electric charges underwater.

(8) Breaking, cutting, damaging, taking, or removing any bottom formation.

(9) Moving, removing, damaging, or possessing, or attempting to move, remove, damage, or possess, any sanctuary historical resource.

(10) Anchoring, or attempting to anchor, any vessel in the Sanctuary, except as provided in paragraph (d) of this section when responding to an emergency threatening life, property, or the environment.

(11) Possessing or carrying any fishing gear within the sanctuary except:

(i) Rod and reel, and handline gear;
(ii) Fishing gear other than rod and reel, handline gear, and spearfishing gear, provided that it is stowed on a vessel and not available for immediate use;
(iii) Spearfishing gear provided that it is stowed on a vessel, not available for immediate use, and the vessel is passing through the sanctuary without interruption; and
(iv) For law enforcement purposes.

In addition to the prohibitions outlined in 15 CFR section 922.92(a), which apply throughout the Sanctuary, the following activities are prohibited and thus unlawful for any person to conduct or cause to be conducted within the research area (15 CFR section 922.94):

(a)

(1) Injuring, catching, harvesting, or collecting, or attempting to injure, catch, harvest, or collect, any marine organism, or any part thereof, living or dead.
(2) There shall be a rebuttable presumption that any marine organism or part thereof referenced in this paragraph found in the possession of a person within the research area has been collected from the research area.

(b) Using any fishing gear, or possessing, or carrying any fishing gear unless such gear is stowed and not available for immediate use while on board a vessel transiting through the research area without interruption or for valid law enforcement purposes.
(c) Diving.
(d) Stopping a vessel in the research area.

All activities carried out by the DoD within the sanctuary at the time of designation were considered essential for national defense, and therefore, are not subject to the sanctuary's general prohibitions. These activities include surface and aerial gunnery, bombing, torpedo and missile activities, as well as vessel and submarine maneuvers, and aircraft overflights (typically above 1,500 feet or beyond a 1 NM radius of the sanctuary). The exemption of additional activities having significant impacts shall be determined in consultation between the Office of National Marine Sanctuaries and the DoD.

The Gray's Reef National Marine Sanctuary Final Environmental Assessment for Implementation of the Sanctuary Management Plan and New Regulations was released in July 2014 (Office of National Marine Sanctuaries, 2014). Specifically, the document states:

> Ongoing and proposed military activities, primarily U.S. Navy Atlantic Fleet Training and Testing operations, including active sonar, have the potential to adversely impact the habitat and living marine resources of the affected environment. The extent of these activities, however, and the potential to affect GRNMS biological and physical resources is unknown due to national defense protocols.

The Navy considered all proposed training and testing activities that could occur within the sanctuary, and identified that the proposed activities could fall into the following categories:

1. The following platforms, sources, or items that are part of Navy activities may be used within the Gray's Reef National Marine Sanctuary because they were carried out at the time the regulations were promulgated and therefore are not prohibited:

    - <u>Aircraft and Aerial Targets</u>

Aircraft and aerial targets are expected to cause only a minor and temporary behavioral reaction due to noise for marine mammals (reactions do not rise to the level of take under the MMPA), sea turtles, birds, or fishes that may be present in the area. However, in addition to behavioral reactions due to noise, there is potential for seabirds to be struck by aircraft or aerial targets. As discussed in Section 2.3.3 (Standard Operating Procedures), the Navy implements standard operating procedures for aircraft safety that will reduce the potential for aircraft strikes. For a more detailed discussion of potential impacts to these resources from the use of aircraft and aerial targets, see the following sections:

Section 3.6.3.4.3 (Impacts from Aircraft and Aerial Targets) for fishes
Section 3.7.3.4.3 (Impacts from Aircraft and Aerial Targets) for marine mammals
Section 3.8.3.4.3 (Impacts from Aircraft and Aerial Targets) for reptiles
Section 3.9.3.4.3 (Impacts from Aircraft and Aerial Targets) for birds, which includes discussion of applicable seabirds

- Vessels and in-water devices (that do not make contact with seafloor)

Noise from vessels and in-water devices (excluding sonar and other active acoustic sources) is expected to cause only a minor and temporary behavioral reaction for marine mammals (reactions do not rise to the level of take under the MMPA), sea turtles, seabirds, or fishes that may be present in the area. There is potential for marine mammals, sea turtles, seabirds, floating vegetation, invertebrates, and large slow-moving fish species, to be struck by or to collide with vessels. As discussed in Section 2.3.3 (Standard Operating Procedures), the Navy implements standard operating procedures for vessel and towed in-water device safety that will reduce the marine mammal strike potential. As discussed in Section 5.3.4 (Physical Disturbance and Strike Stressors), the Navy will implement mitigation to further reduce the potential for marine mammal strikes by vessels and in-water devices. For a more detailed discussion of potential impacts to these resources from the use of vessels and in-water devices, see the following sections:

Section 3.3.3.4.1 (Impacts from Vessels and In-Water Devices) for vegetation
Section 3.4.3.4.1 (Impacts from Vessels and In-Water Devices) for invertebrates
Section 3.6.3.4.1 (Impacts from Vessels and In-Water Devices) for fishes
Section 3.7.3.4.1 (Impacts from Vessels and In-Water Devices) for marine mammals
Section 3.8.3.4.1 (Impacts from Vessels and In-Water Devices) for reptiles
Section 3.9.3.4.1 (Impacts from Vessels and In-Water Devices) for birds

- Explosives detonated in-air or at the surface (includes gunnery, bombing, torpedoes, and missiles)

Explosives detonated in-air or at the surface could impact marine mammals, sea turtles, birds, invertebrates, floating vegetation, or fishes that may be present in the area. Impacts are expected to range from temporary behavioral reactions to injury, damage, or death. As discussed in Section 5.3.3 (Explosive Stressors), the Navy will implement mitigation to avoid impacts from explosives on marine mammals and sea turtles. For a more detailed discussion of potential impacts to these resources from the use of explosives detonated in-air or at the surface, see the following sections:

Section 3.3.3.2.1 (Impacts from Explosives) for vegetation
Section 3.4.3.2.1 (Impacts from Explosives) for invertebrates
Section 3.6.3.2.1 (Impacts from Explosives) for fishes
Section 3.7.3.2.1 (Impacts from Explosives) for marine mammals
Section 3.8.3.2.1 (Impacts from Explosives) for reptiles
Section 3.9.3.2.1 (Impacts from Explosives) and Section 3.9.3.1.3 (Impacts from Air Guns) for birds

- Military expended materials resulting from exempted activities

Military expended materials resulting from exempted activities include fragments from high-explosive munitions, non-explosive practice munitions, and targets. These items could directly strike marine mammals, sea turtles, birds, invertebrates, floating vegetation, or fishes that may be present in the area. However, the probability of military expended materials directly striking a marine resource is extremely low. As discussed in Section 5.3.4 (Physical Disturbance and Strike Stressors) and Section 5.4.1 (Mitigation Areas for Seafloor Resources), the Navy will implement mitigation to avoid impacts from military expended materials on marine mammals, sea turtles, and applicable seafloor resources. For a more detailed discussion of potential impacts to these resources from the use of non-explosive practice munitions fired in-air or at the surface, see the following sections:

Section 3.3.3.4.3 (Impacts from Military Expended Materials) for vegetation
Section 3.4.3.4.3 (Impacts from Military Expended Materials) for invertebrates
Section 3.5.3.4.3 (Impacts from Military Expended Materials) for habitats
Section 3.6.3.4.3 (Impacts from Military Expended Materials) for fishes
Section 3.7.3.4.3 (Impacts from Military Expended Materials) for marine mammals
Section 3.8.3.4.3 (Impacts from Military Expended Materials) for reptiles
Section 3.9.3.4.3 (Impacts from Military Expended Materials) for birds

2. The following platforms, sources, or items that are part of Navy activities were not conducted at the time that the sanctuary regulations were promulgated but may be used within the Gray's Reef National Marine Sanctuary because they would not cause significant impacts on sanctuary resources:

- Sonar and other active acoustic sources

Sonar and other active acoustic sources are expected to cause only a minor and temporary behavioral reaction for invertebrates (cephalopods and crustaceans), diving birds, or fished that may be present in the area. No effect is anticipated to corals. There is potential for marine mammals and sea turtles to be injured (permanent threshold shifts in hearing) from sonar and other active acoustic sources. However, due to the water depth in the vicinity of the sanctuary, the types of active sonar and other acoustic sources that could be used would typically be limited to lower source levels and higher frequency systems such as mine-hunting, bottom mapping and underwater communication type systems. Regarding the more powerful hull-mounted mid-frequency sonars, the types of activities that could occur would typically be limited to maintenance, testing or mine countermeasure training, and these events would typically be less than an hour in the vicinity of the sanctuary. Therefore, the likelihood of causing significant impacts on sanctuary resources, including marine mammals or sea turtles, is low. As discussed in Section 5.3.2 (Acoustic Stressors), the Navy will implement mitigation to avoid impacts from sonar on marine mammals and sea turtles. For a more detailed discussion of potential impacts to these resources from the use of sonar and other active acoustic sources, see the following sections:

Section 3.4.3.1.2 (Impacts from Sonar and Other Transducers) for invertebrates
Section 3.6.3.1.2 (Impacts from Sonar and Other Transducers) for fishes
Section 3.7.3.1.2 (Impacts from Sonar and Other Transducers) for marine mammals
Section 3.8.3.1.2 (Impacts from Sonar and Other Transducers) for reptiles
Section 3.9.3.1.2 (Impacts from Sonar and Other Transducers) for birds

- Electromagnetic devices

Electromagnetic devices are expected to cause only a minor and temporary behavioral reaction for marine mammals (reactions do not rise to the level of take under the MMPA), sea turtles, birds, invertebrates (arthropods, such as lobsters), or fishes that may be present in the area. For a more detailed discussion of potential impacts to these resources from the use of electromagnetic devices, see the following sections:

Section 3.4.3.3.1 (Impacts from In-Water Electromagnetic Devices) and Section 3.4.3.3.2 (Impacts from In-Air Electromagnetic Devices) for invertebrates
Section 3.6.3.3.1 (Impacts from In-Water Electromagnetic Devices) and Section 3.6.3.3.2 (Impacts from In-Air Electromagnetic Devices) for fishes
Section 3.7.3.3.1 (Impacts from In-Water Electromagnetic Devices) and Section 3.7.3.3.2 (Impacts from In-Air Electromagnetic Devices) for marine mammals
Section 3.8.3.3.1 (Impacts from In-Water Electromagnetic Devices) and Section 3.8.3.3.2 (Impacts from In-Air Electromagnetic Devices) for reptiles
Section 3.9.3.3.1 (Impacts from In-Water Electromagnetic Devices) and Section 3.9.3.3.2 (Impacts from In-Air Electromagnetic Devices) for birds

3. The following platforms, sources, or items are part of Navy activities, but are not planned to be used within the Gray's Reef National Marine Sanctuary (including a 2.7 NM buffer) as part of the Proposed Action:

- Explosives detonated underwater
- Military expended materials resulting from non-exempted activities
- Seafloor devices

The Navy's Proposed Action is consistent with the activities that were occurring when the Gray's Reef National Marine Sanctuary was designated, as well as during the development of the 2014 Management Plan. The Navy does not propose to conduct any new activities that would cause significant impacts on Sanctuary resources. Furthermore, the Navy does not propose to increase the level of existing activities within the Sanctuary from what was previously considered at the time of sanctuary designation. Since activities conducted in and around the sanctuary could potentially result in harassment takes under the MMPA (defined as an injury to a sanctuary resource by the Office of National Marine Sanctuaries) the Navy consulted under section 304(d) of the National Marine Sanctuaries Act. On 15 May 2018, in an injury determination letter in response to the Navy's sanctuary resource statement, the Office of National Marine Sanctuaries concluded that the Proposed Action is likely to cause injury to sanctuary resources, but given ongoing research and current Navy mitigations, no sanctuary-specific reasonable and prudent alternatives were issued under this consultation.

6.1.2.6.4 Florida Keys National Marine Sanctuary

The Florida Keys National Marine Sanctuary is located within portions of the Southeast U.S. Continental Shelf, Caribbean Sea, and Gulf of Mexico Large Marine Ecosystems (Figure 6.1-6). The geographical extent of the sanctuary encompasses an area 2,900 NM^2, including waters surrounding the 126 mile long Florida Keys archipelago, Florida Bay, and portions of the Gulf of Mexico and Atlantic Ocean (National Marine Sanctuary Program, 2007a). The sanctuary was established in 1990 to preserve historical, cultural, and natural resources, including coral reefs, shipwrecks, seagrass beds, and fisheries. The Florida Keys National Marine Sanctuary contains a complex marine ecosystem that supports a variety of unique and nationally significant habitats: seagrass meadows, mangrove islands, and extensive living coral reefs. The ecosystem supports more than 6,000 species of plants, fish, and invertebrates, including the nation's only coral reef that lies next to the continent and one of the largest seagrass communities in the hemisphere (National Marine Sanctuary Program, 2007a).

Management of the Florida Keys National Marine Sanctuary involves a zoning strategy, with regulations applicable to either the entire sanctuary or to specific zones. Regulations focus on reducing direct and indirect threats to the reef by protecting ecologically important habitats and resources and improving water quality. Sanctuary-wide regulations prohibit the following (15 CFR section 922.163(a)):

(1) Mineral and hydrocarbon exploration, development and production. Exploring for, developing, or producing minerals or hydrocarbons within the sanctuary.

(2) Removal of, injury to, or possession of coral or live rock.

  (i) Moving, removing, taking, harvesting, damaging, disturbing, touching, breaking, cutting, or otherwise injuring, or possessing (regardless of where taken from) any living or dead coral, or coral formation, or attempting any of these activities, except as permitted under 50 CFR part 622.

  (ii) Harvesting, or attempting to harvest, any live rock from the sanctuary, or possessing (regardless of where taken from) any live rock within the sanctuary, except as authorized by a permit for the possession or harvest from aquaculture operations in the Exclusive Economic Zone, issued by the National Marine Fisheries Service pursuant to applicable regulations under the appropriate Fishery Management Plan, or as authorized by the applicable State authority of competent jurisdiction within the sanctuary for live rock cultured on State submerged lands leased from the State of Florida, pursuant to applicable State law. See section 370.027, Florida Statutes and implementing regulations.

(3) Alteration of, or construction on, the seabed. Drilling into, dredging, or otherwise altering the seabed of the sanctuary, or engaging in prop-dredging; or constructing, placing or abandoning any structure, material, or other matter on the seabed of the sanctuary, except as an incidental result of:

  (i) Anchoring vessels in a manner not otherwise prohibited by this part (see sections 922.163(a)(5)(ii) and 922.164(d)(1)(v));

(ii) Traditional fishing activities not otherwise prohibited by this part;
(iii) Installation and maintenance of navigational aids by, or pursuant to valid authorization by, any Federal, State, or local authority of competent jurisdiction;
(iv) Harbor maintenance in areas necessarily associated with federal water resource development projects in existence on July 1, 1997, including maintenance dredging of entrance channels and repair, replacement, or rehabilitation of breakwaters or jetties;
(v) Construction, repair, replacement, or rehabilitation of docks, seawalls, breakwaters, piers, or marinas with less than ten slips authorized by any valid lease, permit, license, approval, or other authorization issued by any Federal, State, or local authority of competent jurisdiction.

(4) Discharge or deposit of materials or other matter.

(i) Discharging or depositing, from within the boundary of the sanctuary, any material or other matter, except:

(A) Fish, fish parts, chumming materials, or bait used or produced incidental to and while conducting a traditional fishing activity in the sanctuary;
(B) Water generated by routine vessel operations (e.g., deck wash down and graywater as defined in Section 312 of the Federal Water Pollution Control Act), excluding oily wastes from bilge pumping; or
(C) Cooling water from vessels or engine exhaust;

(ii) Discharging or depositing, from beyond the boundary of the sanctuary, any material or other matter that subsequently enters the sanctuary and injures a sanctuary resource or quality, except:

(A) Those listed in paragraph (a)(4)(i)(A) through (a)(4)(i)(C) of this section;
(B) Sewage incidental to vessel use and generated by a marine sanitation device approved in accordance with Section 312 of the Federal Water Pollution Control Act, as amended, 33 U.S.C. 1322 et seq.;
(C) Those authorized under Monroe County land use permits; or
(D) Those authorized under State permits.

(5) Operation of vessels.

(i) Operating a vessel in such a manner as to strike or otherwise injure coral, seagrass, or any other immobile organism attached to the seabed, including, but not limited to, operating a vessel in such a manner as to cause prop-scarring.
(ii) Having a vessel anchored on living coral other than hard bottom in water depths less than 40 feet when visibility is such that the seabed can be seen.
(iii) Except in officially marked channels, operating a vessel at a speed greater than 4 knots or in manner which creates a wake:

(A) Within an area designated idle speed only/no wake;
(B) Within 100 yards of navigational aids indicating emergent or shallow reefs (international diamond warning symbol);

(C) Within 100 yards of the red and white "divers down" flag (or the blue and white "alpha" flag in Federal waters);
(D) Within 100 yards of residential shorelines; or
(E) Within 100 yards of stationary vessels.

(iv) Operating a vessel in such a manner as to injure or take wading, roosting, or nesting birds or marine mammals.
(v) Operating a vessel in a manner which endangers life, limb, marine resources, or property.
(vi) Having a marine sanitation device that is not secured in a manner that prevents discharges or deposits of treated and untreated sewage. Acceptable methods include, but are not limited to, all methods that have been approved by the U.S. Coast Guard (at 33 CFR section 159.7(b) and (c)).

(6) Conduct of diving/snorkeling without flag. Diving or snorkeling without flying in a conspicuous manner the red and white "divers down" flag (or the blue and white "alpha" flag in Federal waters).
(7) Release of exotic species. Introducing or releasing an exotic species of plant, invertebrate, fish, amphibian, or mammals into the sanctuary.
(8) Damage or removal of markers. Marking, defacing, or damaging in any way or displacing, removing, or tampering with any official signs, notices, or placards, whether temporary or permanent, or with any navigational aids, monuments, stakes, posts, mooring buoys, boundary buoys, trap buoys, or scientific equipment.
(9) Movement of, removal of, injury to, or possession of sanctuary historical resources. Moving, removing, injuring, or possessing, or attempting to move, remove, injure, or possess, a sanctuary historical resource.
(10) Take or possession of protected wildlife. Taking any marine mammal, sea turtle, or seabird in or above the sanctuary, except as authorized by the Marine Mammal Protection Act, as amended, (MMPA), 16 U.S.C. 1361 et seq., the Endangered Species Act, as amended, (ESA), 16 U.S.C. 1531 et seq., and the Migratory Bird Treaty Act, as amended, (MBTA) 16 U.S.C. 703 et seq.
(11) Possession or use of explosives or electrical charges. Possessing, or using explosives, except powerheads, or releasing electrical charges within the sanctuary.
(12) Harvest or possession of marine life species. Harvesting, possessing, or landing any marine life species, or part thereof, within the sanctuary, except in accordance with rules 68B–42 of the Florida Administrative Code, and such rules shall apply mutatis mutandis (with necessary editorial changes) to all Federal and State waters within the sanctuary.
(13) Interference with law enforcement. Interfering with, obstructing, delaying or preventing an investigation, search, seizure, or disposition of seized property in connection with enforcement of the Acts or any regulation or permit issued under the Acts.

The prohibitions listed above and at 15 CFR section 922.164 do not apply to existing classes of DoD military activities conducted prior to the effective date of these regulations as identified in the EIS and Management Plan for the sanctuary (15 CFR section 922.163(d)(1)). New military activities in the sanctuary are allowed and may be exempted from the prohibitions summarized after consultation between the Office of National Marine Sanctuaries and the Navy pursuant to Section 304(d) of the National Marine Sanctuary Act. An activity is considered new when it is modified so it is likely to destroy, cause the loss of, or injure a sanctuary resource or quality in a manner significantly greater than was considered in a previous consultation under section 304(d) of the National Marine Sanctuary Act. All military activities shall be carried out in a manner that avoids to the maximum extent practicable any adverse impacts on Sanctuary resources and qualities.

The Navy has played an important role in the lower Florida Keys since the early 1800s. Existing classes of DoD military activities conducted prior to the effective date of sanctuary regulations and identified in the original Final Management Plan/EIS for the Florida Keys National Sanctuary (National Marine Sanctuary Program, 1996) include:

- Research on radar and missile systems and test missile operations and evaluation
- Underwater explosives testing (including weapon systems testing and shock testing of ship hull designs) in "Site A"
- Mine countermeasure research
- Corrosion and coatings tests
- Acoustic research
- General air operations
- Air combat maneuvering
- Air-to-surface ordnance (inert ordnance and smoke markers) at Patricia Range
- Submarine activities (including firing and recovery of non-explosive torpedoes outside sanctuary)
- Sonobuoy testing and diver training (typically includes recovery of sonobuoys)
- Special warfare activities at Fleming Key
- Search and rescue
- General transits, anchoring in designated areas, moorings, and pierside maintenance at Naval Air Station Key West piers
- Harbor management
- Fuel deliveries

The Florida Keys National Marine Sanctuary Revised Management Plan was released in December 2007 (National Marine Sanctuary Program, 2007a). The 2007 revised management plan does not alter the exemptions of the original 1996 management plan/environmental impact statement (National Marine Sanctuary Program, 1996).

To ensure compliance with the Office of National Marine Sanctuaries Regulations, the Navy considered all proposed training and testing activities that could occur within the sanctuary. All activities would be conducted in a manner that avoids to the maximum extent practicable any adverse impacts on sanctuary resources. The Navy concluded that the proposed activities could fall into the following categories:

1. The following platforms, sources, or items that are part of Navy activities may be used within the Florida Keys National Marine Sanctuary because they are either exempted from the prohibitions as pre-existing activities (i.e., were conducted prior to the effective date of these regulations) or do not involve prohibited activities:

   - <u>Aircraft and Aerial Targets</u>

   Aircraft and aerial targets are expected to cause only a minor and temporary behavioral reaction due to noise for marine mammals (reactions do not rise to the level of take under the MMPA), sea turtles, birds, or fishes that may be present in the area. However, in addition to behavioral reactions due to noise, there is potential for seabirds to be struck by aircraft or aerial targets. As discussed in Section 2.3.3 (Standard Operating Procedures), the Navy implements standard operating procedures for aircraft safety that will reduce the potential for aircraft strikes. For a more detailed discussion of potential impacts to these resources from the use of aircraft and aerial targets, see the following sections:

Section 3.6.3.4.2 (Impacts from Aircraft and Aerial Targets) for fishes
Section 3.7.3.4.2 (Impacts from Aircraft and Aerial Targets) for marine mammals
Section 3.8.3.4.2 (Impacts from Aircraft and Aerial Targets) for reptiles
Section 3.9.3.4.2 (Impacts from Aircraft and Aerial Targets) for birds, which includes discussion of applicable seabirds

- Vessels and in-water devices (that do not make contact with seafloor)

Noise from vessels and in-water devices (excluding sonar and other active acoustic sources) is expected to cause only a minor and temporary behavioral reaction for marine mammals (reactions do not rise to the level of take under the MMPA), sea turtles, seabirds, or fishes that may be present in the area. There is potential for marine mammals, sea turtles, seabirds, floating vegetation, invertebrates, and large slow-moving fish species, to be struck by or to collide with vessels. As discussed in Section 2.3.3 (Standard Operating Procedures), the Navy implements standard operating procedures for vessel and towed in-water device safety that will reduce the marine mammal strike potential. As discussed in Section 5.3.4 (Physical Disturbance and Strike Stressors), the Navy will implement mitigation to further reduce the potential for marine mammal strikes by vessels and in-water devices. For a more detailed discussion of potential impacts to these resources from the use of vessels and in-water devices, see the following sections:

Section 3.3.3.4.1 (Impacts from Vessels and In-Water Devices) for vegetation
Section 3.4.3.4.1 (Impacts from Vessels and In-Water Devices) for invertebrates
Section 3.6.3.4.1 (Impacts from Vessels and In-Water Devices) for fishes
Section 3.7.3.4.1 (Impacts from Vessels and In-Water Devices) for marine mammals
Section 3.8.3.4.1 (Impacts from Vessels and In-Water Devices) for reptiles
Section 3.9.3.4.1 (Impacts from Vessels and In-Water Devices) for birds

- Sonar and other active acoustic sources (including mine countermeasure research, acoustic research, submarine activities, sonobuoy testing, and special warfare activities)

Sonar and other active acoustic sources are expected to cause only a minor and temporary behavioral reaction for marine mammals, sea turtles, invertebrates (cephalopods and crustaceans), diving birds, or fishes that may be present in the area. No effect is anticipated to corals. There is potential for marine mammals and sea turtles to be injured (permanent threshold shifts in hearing) from sonar and other active acoustic sources. As discussed in Section 5.3.2 (Acoustic Stressors), the Navy will implement mitigation to avoid impacts from sonar on marine mammals and sea turtles. For a more detailed discussion of potential impacts to these resources from the use of sonar and other active acoustic sources, see the following sections:

Section 3.4.3.1.2 (Impacts from Sonar and Other Transducers) for invertebrates
Section 3.6.3.1.2 (Impacts from Sonar and Other Transducers) for fishes
Section 3.7.3.1.2 (Impacts from Sonar and Other Transducers) for marine mammals
Section 3.8.3.1.2 (Impacts from Sonar and Other Transducers) for reptiles
Section 3.9.3.1.2 (Impacts from Sonar and Other Transducers) for birds

2. The following platforms, sources, or items that are part of Navy activities but were not conducted as of the effective date of the regulations may be used within the Florida Keys National Marine Sanctuary because they are not a prohibited activity under the sanctuary regulations:

 - <u>Electromagnetic devices</u>

 Electromagnetic devices are expected to cause only a minor and temporary behavioral reaction for marine mammals (reactions do not rise to the level of take under the MMPA), sea turtles, birds, invertebrates (arthropods, such as lobsters), or fish that may be present in the area. For a more detailed discussion of potential impacts to these resources from the use of electromagnetic devices, see the following sections:

 Section 3.4.3.3.2 (Impacts from In-Water Electromagnetic Devices) and Section 3.4.3.3.3 (Impacts from In-Air Electromagnetic Devices) for invertebrates
 Section 3.6.3.3.2 (Impacts from In-Water Electromagnetic Devices) and Section 3.6.3.3.3 (Impacts from In-Air Electromagnetic Devices) for fishes
 Section 3.7.3.3.2 (Impacts from In-Water Electromagnetic Devices) and Section 3.7.3.3.3 (Impacts from In-Air Electromagnetic Devices) for marine mammals
 Section 3.8.3.3.2 (Impacts from In-Water Electromagnetic Devices) and Section 3.8.3.3.3 (Impacts from In-Air Electromagnetic Devices) for reptiles
 Section 3.9.3.3.2 (Impacts from In-Water Electromagnetic Devices) and Section 3.9.3.3.3 (Impacts from In-Air Electromagnetic Devices) for birds

3. The following platforms, sources, or items that are part of Navy activities, but are not planned to be used within the Florida Keys National Marine Sanctuary (including a 2.7 NM buffer) as part of the Proposed Action:

 - Sonar and other active acoustic sources (not included in activities listed in Category 1 above)
 - Explosives detonated in-air, at the surface, or underwater (with the exception of limpet mine events which occur within the Sanctuary boundaries)
 - Military expended materials
 - Seafloor devices

Activities the Navy proposes to conduct in the Florida Keys National Marine Sanctuary are within the classes of activities exempted from requiring a permit as of the effective date of the sanctuary regulations and are consistent with Navy activities and planning included in the most recent management plan. Navy activities have not been modified as to be more likely to destroy, cause the loss of, or injure a sanctuary resource or quality in a manner significantly greater than was previously considered when exempted or in the management plan. Further, the Navy does not propose to increase the level of existing activities within the sanctuary from what was previously considered at the time of sanctuary designation. Since activities conducted in and around the sanctuary could potentially result in harassment takes under the MMPA (defined as an injury to a sanctuary resource by the Office of National Marine Sanctuaries) the Navy consulted under section 304(d) of the National Marine Sanctuaries Act. On 15 May 2018, in an injury determination letter in response to the Navy's sanctuary resource statement, the Office of National Marine Sanctuaries recommended, and Navy concurred, that the Navy continue to obtain updated data regarding sea turtle densities to support future higher resolution modeling to further evaluate potential impacts to sea turtles from explosive stressors in Florida Keys National Marine Sanctuary.

6.1.2.6.5 Flower Garden Banks National Marine Sanctuary

The Flower Garden Banks National Marine Sanctuary is located within the northwestern portion of the Gulf of Mexico Large Marine Ecosystem, nearly 96 NM offshore of Texas and Louisiana (Figure 6.1-6). The Flower Garden Banks National Marine Sanctuary was designated in 1992 to include East Flower Garden Bank and West Flower Garden Bank, and was expanded in 1996 to include Stetson Bank. Now encompassing an area of 42.34 NM^2, the sanctuary is designed to preserve the ecological and recreational value of three areas of coral reef that exist atop salt domes rising from the ocean floor. The East and West Flower Garden Banks coral reef ecosystem and associated biological communities support nearly 280 fish species, as well as loggerhead and hawksbill sea turtles, and a variety of shark, ray, and invertebrate species. Shark species found at the sanctuary include scalloped hammerhead sharks, sandbar sharks, tiger sharks, spinner sharks, and whale sharks (Office of National Marine Sanctuaries, 2008). Stetson Bank is primarily habitat for sponge communities, but is also scattered with coral colonies and provides habitat for diverse fish and plant assemblages (Moretzsohn et al., 2011). The sanctuary is used for recreational fishing and diving, which in some isolated cases has degraded the quality of reef habitat because of damage from anchoring (Office of National Marine Sanctuaries, 2008).

General regulations for Flower Garden Banks National Marine Sanctuary prohibit the following (15 CFR section 922.122(a)):

(1) Exploring for, developing, or producing oil, gas, or minerals except outside of all no-activity zones and provided all drilling cuttings and drilling fluids are shunted to the seabed through a downpipe that terminates an appropriate distance, but no more than ten meters, from the seabed.

(2) (i) Anchoring any vessel within the sanctuary.
(ii) Mooring any vessel within the sanctuary, except that vessels 100 feet (30.48 meters) or less in registered length may moor to a sanctuary mooring buoy.
(iii) Mooring a vessel in the sanctuary without clearly displaying the blue and white International Code flag "A" ("alpha" dive flag) or the red and white "sports diver" flag whenever a SCUBA diver from that vessel is in the water and removing the "alpha" dive flag or "sports diver" flag after all SCUBA divers exit the water and return back on board the vessel, consistent with U.S. Coast Guard guidelines relating to sports diving as contained within "Special Notice to Mariners" (00–208) for the Gulf of Mexico.

(3) (i) Discharging or depositing from within or into the sanctuary any material or other matter except:

(A) Fish, fish parts, chumming materials, or bait used in or resulting from fishing with conventional hook and line gear in the sanctuary, provided that such discharge or deposit occurs during the conduct of such fishing within the sanctuary;
(B) Clean effluent generated incidental to vessel use by an operable Type I or Type II marine sanitation device (U.S. Coast Guard classification) approved in accordance with Section 312 of the Federal Water Pollution Control Act, as amended 33 U.S.C. 1322. Vessel operators must lock marine sanitation devices in a manner that prevents discharge or deposit of untreated sewage;
(C) Clean vessel deck wash down, clean vessel engine cooling water, clean vessel generator cooling water, clean bilge water, or anchor wash;
(D) Engine exhaust;
(E) In areas of the sanctuary outside the no-activity zones, drilling cuttings and drilling fluids necessarily discharged incidental to the exploration for, development of, or production of oil or gas in those areas and in accordance with the shunting requirements of paragraph (a)(1) of this section unless such discharge injures a sanctuary resource or quality.

(ii) Discharging or depositing, from beyond the boundaries of the sanctuary, any material or other matter, except those listed in paragraphs (a)(3)(i)(A) through (D) of this section, that subsequently enters the sanctuary and injures a sanctuary resource or quality.

(4) Drilling into, dredging, or otherwise altering the seabed of the sanctuary (except as allowed under paragraph (c) of this section); or constructing, placing, or abandoning any structure, material, or other matter on the seabed of the sanctuary.
(5) Injuring or removing, or attempting to injure or remove, any coral or other bottom formation, coralline algae or other plant, marine invertebrate, brine-seep biota, or carbonate rock within the sanctuary.
(6) Taking any marine mammal or turtle within the sanctuary, except as permitted by regulations, as amended, promulgated under the Marine Mammal Protection Act, as amended, 16 U.S.C. 1361 et seq., and the Endangered Species Act, as amended, 16 U.S.C. 1531 et seq.
(7) Killing, injuring, attracting, touching, or disturbing a ray or whale shark in the sanctuary. Notwithstanding the above, the incidental and unintentional injury to a ray or whale shark as a result of fishing with conventional hook and line gear is exempted from this prohibition.
(8) Injuring, catching, harvesting, collecting, or feeding, or attempting to injure, catch, harvest, collect, or feed, any fish within the sanctuary by use of bottom longlines, traps, nets, bottom trawls, or any other gear, device, equipment, or means except by use of conventional hook and line gear.
(9) Possessing within the sanctuary (regardless of where collected, caught, harvested or removed), except for valid law enforcement purposes, any carbonate rock, coral or other bottom formation, coralline algae or other plant, marine invertebrate, brine-seep biota, or fish (except for fish caught by use of conventional hook and line gear).
(10) Possessing or using within the sanctuary, except possessing while passing without interruption through it or for valid law enforcement purposes, any fishing gear, device, equipment or means except conventional hook and line gear.

(11) Possessing, except for valid law enforcement purposes, or using explosives or releasing electrical charges within the sanctuary.

The prohibitions listed above do not apply to activities being carried out by the DoD as of the effective date of sanctuary designation. Pre-existing Navy activities will be carried out in a manner that minimizes any adverse impact on sanctuary resources and qualities. New activities may be carried out by the DoD if they do not have the potential for any significant adverse impacts on sanctuary resources or qualities. New activities with the potential for significant adverse impacts on sanctuary resources or qualities may be exempted after consultation between the Office of National Marine Sanctuaries and the DoD. If it is determined that an activity may be carried out, such activity shall be carried out in a manner that minimizes any adverse impact on sanctuary resources and qualities (15 CFR section 922.122(e)(1)). Activities that were carried out prior to the effective date of the sanctuary designation and identified in the original Final EIS/Management Plan for the Flower Garden Banks National Sanctuary (National Marine Sanctuary Program, 1991) include:

- Carrier maneuvers
- Missile testing and development
- Rocket firing
- Air-to-air gunnery
- Air-to-surface gunnery
- Minesweeping operations
- Submarine operations
- Air combat maneuvers
- Aerobatic training
- Instrument training

The Flower Garden Banks National Marine Sanctuary Final Management Plan was released in April 2012 (Office of National Marine Sanctuaries, 2012), which included a summary of the revised environmental impact statement and contained the revised regulations as an appendix. The 2012 revised management plan does not alter the exemptions of the original 1991 management plan/environmental impact statement (National Marine Sanctuary Program, 1991).

The Navy considered all proposed training and testing activities that could occur within the sanctuary. All activities would be conducted in a manner that avoids to the maximum extent practicable any adverse impacts on sanctuary resources. The Navy concluded that the proposed activities could fall into the following two categories:

1. The following platforms, sources, or items that are part of Navy activities may be used within the Flower Garden Banks National Marine Sanctuary because they (1) do not have the potential for any significant adverse impacts on sanctuary resources or qualities, and (2) are carried out in a manner that minimizes any adverse impact on sanctuary resources and qualities:

    - <u>Aircraft and Aerial Targets</u>

    Aircraft and aerial targets are expected to cause only a minor and temporary behavioral reaction due to noise for marine mammals (reactions do not rise to the level of take under the MMPA), sea turtles, birds, or fishes that may be present in the area. However, in addition to behavioral reactions due to noise, there is potential for seabirds to be struck by aircraft or aerial targets. As discussed in Section 2.3.3 (Standard Operating Procedures), the Navy implements standard operating procedures for aircraft safety that will reduce the potential for aircraft strikes. For a more detailed discussion of potential impacts to these resources from the use of aircraft and aerial targets, see the following sections:

Section 3.6.3.4.2 (Impacts from Aircraft and Aerial Targets) for fishes
Section 3.7.3.4.2 (Impacts from Aircraft and Aerial Targets) for marine mammals
Section 3.8.3.4.2 (Impacts from Aircraft and Aerial Targets) for reptiles
Section 3.9.3.4.2 (Impacts from Aircraft and Aerial Targets) for birds, which includes discussion of applicable seabirds

- Vessels and in-water devices

Noise from vessels and in-water devices (excluding sonar and other active acoustic sources) is expected to cause only a minor and temporary behavioral reaction for marine mammals (reactions do not rise to the level of take under the MMPA), sea turtles, seabirds, or fishes that may be present in the area. There is potential for marine mammals, sea turtles, seabirds, floating vegetation, invertebrates, and large slow-moving fish species, to be struck by or to collide with vessels. As discussed in Section 2.3.3 (Standard Operating Procedures), the Navy implements standard operating procedures for vessel and towed in-water device safety that will reduce the marine mammal strike potential. As discussed in Section 5.3.4 (Physical Disturbance and Strike Stressors), the Navy will implement mitigation to further reduce the potential for marine mammal strikes by vessels and in-water devices. For a more detailed discussion of potential impacts to these resources from the use of vessels and in-water devices, see the following sections:

Section 3.3.3.4.1 (Impacts from Vessels and In-Water Devices) for vegetation
Section 3.4.3.4.1 (Impacts from Vessels and In-Water Devices) for invertebrates
Section 3.6.3.4.1 (Impacts from Vessels and In-Water Devices) for fishes
Section 3.7.3.4.1 (Impacts from Vessels and In-Water Devices) for marine mammals
Section 3.8.3.4.1 (Impacts from Vessels and In-Water Devices) for reptiles
Section 3.9.3.4.1 (Impacts from Vessels and In-Water Devices) for birds

- Sonar and other non-impulsive acoustic sources

Sonar and other active acoustic sources are expected to cause only a minor and temporary behavioral reaction for marine mammals (reactions do not rise to the level of take under the MMPA), sea turtles, invertebrates (cephalopods and crustaceans), diving birds, or fishes that may be present in the area. No effect is anticipated to corals. For a more detailed discussion of potential impacts to these resources from the use of sonar and other active acoustic sources, see the Sanctuary Resource Statement (Section 1[ii] Flower Garden Bank National Marine Sanctuary) and the following sections of this FEIS/OEIS:

Section 3.4.3.1.2 (Impacts from Sonar and Other Transducers) for invertebrates
Section 3.6.3.1.2 (Impacts from Sonar and Other Transducers) for fishes
Section 3.7.3.1.2 (Impacts from Sonar and Other Transducers) for marine mammals

Section 3.8.3.1.2 (Impacts from Sonar and Other Transducers) for reptiles
Section 3.9.3.1.2 (Impacts from Sonar and Other Transducers) for birds

- Electromagnetic devices

Electromagnetic devices are expected to cause only a minor and temporary behavioral reaction for marine mammals (reactions do not rise to the level of take under the MMPA), sea turtles, birds, invertebrates (arthropods, such as lobsters), or fishes that may be present in the area. For a more detailed discussion of potential impacts to these resources from the use of electromagnetic devices, see the following sections:

Section 3.4.3.3.1 (Impacts from In-Water Electromagnetic Devices) and Section 3.4.3.3.2 (Impacts from In-Air Electromagnetic Devices) for invertebrates
Section 3.6.3.3.1 (Impacts from In-Water Electromagnetic Devices) and Section 3.6.3.3.2 (Impacts from In-Air Electromagnetic Devices) for fishes
Section 3.7.3.3.1 (Impacts from In-Water Electromagnetic Devices) and Section 3.7.3.3.2 (Impacts from In-Air Electromagnetic Devices) for marine mammals
Section 3.8.3.3.1 (Impacts from In-Water Electromagnetic Devices) and Section 3.8.3.3.2 (Impacts from In-Air Electromagnetic Devices) for reptiles
Section 3.9.3.3.1 (Impacts from In-Water Electromagnetic Devices) and Section 3.9.3.3.2 (Impacts from In-Air Electromagnetic Devices) for birds

2. The following platforms, sources, or items are part of Navy activities, but that are not planned to be used within the Flower Garden Banks National Marine Sanctuary (including a 2.7 NM buffer) as part of the Proposed Action:

- Explosives detonated in-air, at the surface or underwater
- Military expended materials
- Seafloor devices

Activities the Navy proposes to conduct in Flower Garden Banks National Marine Sanctuary are consistent with the activities exempted when the sanctuary was designated and are consistent with Navy activities and planning during the development of the most recent management plan. The Navy does not propose to conduct any new activities that could have significant adverse impacts on sanctuary resources or qualities. Further, the Navy does not propose to increase the level of existing activities within the sanctuary from what was previously considered at the time of sanctuary designation. Since none of the Navy's training and testing activities proposed to be conducted within or in the vicinity of Flower Garden Banks National Marine Sanctuary are likely to injure sanctuary resources, the Navy has determined that it is not required to engage in section 304(d) consultation under the National Marine Sanctuaries Act.

6.1.3 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act of 1976 (16 United U.S.C. section 1801–1891[d]), as amended by the 1996 Sustainable Fisheries Act (Public Law 104–297), and the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 (Public Law 109-479), governs marine fisheries management in U.S. waters in order to promote long-term economic and biological sustainability for fisheries up to 200 NM from shore. Its main objectives are to prevent overfishing, rebuild overfished stocks, increase long-term economic and social benefits, and ensure a safe and sustainable supply of seafood (National Oceanic and Atmospheric Administration Fisheries, 2017). The Sustainable Fisheries Act of 1996 amended the law to establish procedures that identify, conserve, and enhance Essential Fish Habitat for species regulated under a federal fisheries management plan.

Consultation with the National Oceanic and Atmospheric Administration's National Marine Fisheries Service on all actions or proposed actions that may adversely affect Essential Fish Habitat is required for federal action agencies under section 305(b)(2) of the Magnuson-Stevens Act. The Navy submitted Essential Fish Habitat Assessments associated with the Proposed Action to the two regional offices with jurisdiction within the AFTT Study Area, Greater Atlantic Regional Fisheries Office and Southeast Regional Fisheries Office, in February 2018.

The Essential Fish Habitat Assessments included a description of the Navy's Proposed Action and included the following:

- activities and Essential Fish Habitat designations that differ from the previous AFTT EIS/OEIS for which there was a consultation completed in 2012;
- an overview of the Essential Fish Habitat designated within the consultation areas reviewed by the Greater Atlantic Regional Fisheries Office and Southeast Regional Fisheries Office, respectively;
- an analysis of the individual stressor and combined stressor effects of the proposed activity;
- the Navy's determinations regarding the effects of the proposed activity;
- and proposed mitigation measures designed to minimize potential effects from the proposed activities.

With the application of the standard operating procedures and mitigation measures, the Proposed Action (occurring at inshore, pierside and at-sea locations) would have no more than a minimal overall impact on habitats designated as Essential Fish Habitat or Habitat Areas of Particular Concern in the Greater Atlantic Regional Fisheries Office and Southeast Regional Fisheries Office consultation areas. The vast majority of unavoidable impacts would be to the relatively abundant and resilient soft bottom or low relief/ephemeral hard bottom communities in the offshore portion of the AFTT Study Area. The chance of Proposed Action stressors impacting relatively high relief hard bottom, where deep-sea corals and other sedentary invertebrate beds are concentrated, is considered unlikely but not discountable.

Pursuant to the Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, a subset of stressors associated with the proposed training and testing activities (pile driving/extraction, air guns, in-water explosives, military expended materials, seafloor devices, and explosive byproduct contaminants) "may adversely affect" Essential Fish Habitat in the Greater Atlantic Regional Fisheries Office and Southeast Regional Office consultation areas. Mitigations designed to reduce impacts to Essential Fish Habitat have been incorporated into the Proposed Action (see Sections 5.4.1, Mitigation Areas for Seafloor Resources, and 5.4.3, Mitigation Areas off the Mid-Atlantic and Southeastern United States, for more details).

6.2 Relationship Between Short-Term Use of the Environment and Maintenance and Enhancement of Long-Term Productivity

In accordance with the Council on Environmental Quality regulations (40 CFR Part 1502), this EIS/OEIS analyzes the relationship between the short-term impacts on the environment and the effects those impacts may have on the maintenance and enhancement of the long-term productivity of the affected environment. Impacts that narrow the range of beneficial uses of the environment are of particular concern. This means that choosing one option may reduce future flexibility in pursuing other options, or that committing a resource to a certain use may often eliminate the possibility for other uses of that resource. The Navy, in partnership with NMFS, is committed to furthering understanding of marine resources and to developing ways to lessen or eliminate the impacts that Navy training and testing activities may have on these resources. For example, the Navy and NMFS collaborate on the Integrated Comprehensive Monitoring Program for marine species to assess the impacts of training activities on marine species and investigate population-level trends in marine species distribution, abundance, and habitat use in various range complexes and geographic locations where Navy training occurs.

The Proposed Action could result in both short- and long-term environmental impacts. However, these are not expected to result in any impacts that would reduce environmental productivity, permanently narrow the range of beneficial uses of the environment, or pose long-term risks to health, safety, or general welfare of the public. The Navy is committed to sustainable military range management, including co-use of the Study Area with the general public and commercial and recreational interests. This commitment to co-use of the Study Area would maintain long-term accessibility of the AFTT EIS/OEIS training and testing areas. Sustainable range management practices are specified in range complex management plans under the Navy's Range Sustainment Program. Among other benefits, these practices protect and conserve natural and cultural resources and preserve access to training areas for current and future training requirements while addressing potential encroachments that threaten to impact range and training area capabilities.

6.3 Irreversible or Irretrievable Commitment of Resources

NEPA requires that environmental analyses include identification of "any irreversible and irretrievable commitments of resources which would be involved in the Proposed Action should it be implemented" (42 U.S.C. section 4332). Irreversible and irretrievable resource commitments are related to the use of nonrenewable resources and the impacts that the uses of these resources have on future generations. Irreversible impacts primarily result from the use or destruction of a specific resource (e.g., energy or minerals) that cannot be replaced within a reasonable time. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of the action (e.g., the disturbance of a cultural site).

For the Proposed Action, most resource commitments would be neither irreversible nor irretrievable. Most impacts would be short term and temporary, or long lasting but within historical or desired conditions. Because there would be no building or facility construction, the consumption of material typically associated with such construction (e.g., concrete, metal, sand, fuel) would not occur. Energy typically associated with construction activities would not be expended and irretrievably lost.

Implementation of the Proposed Action would require fuels used by aircraft and vessels. Since fixed- and rotary-wing aircraft and ship activities may increase or decrease relative to the baseline, total fuel use would fluctuate depending on the year under the Proposed Action. Therefore, total fuel consumption would fluctuate depending on the year under the Proposed Action (Section 6.4, Energy Requirements and Conservation Potential of Alternatives and Efficiency Initiatives), and this nonrenewable resource would be considered irretrievably lost (see Chapter 4, Cumulative Impacts, and the following discussion on the Navy's Climate Change Roadmap).

6.4 Energy Requirements and Efficiency Initiatives

The DoD consumed approximately 1.3 percent of the total U.S. oil and petroleum consumption in Fiscal Year 2013. It is the largest single user in the nation (Burke, 2014). The Navy consumes approximately 26 percent of the total DoD share (U.S. Department of Defense, 2016). In Fiscal Year 2013, the Navy consumed almost 90 million barrels of liquid fuel (Burke, 2014). In 2016 the DoD published a new Operational Energy Strategy to update the 2011 strategy and transform the way energy is consumed in military operations; the strategy sets the overall direction for operational energy security (U.S. Department of Defense, 2016). The 2016 strategy shifts focus towards three objectives: 1) increasing future warfighting capability by including energy throughout future force development; 2) identifying and reducing logistic and operational risks from operational energy vulnerabilities; 3) and enhancing the force's mission effectiveness with updated equipment and improvements in training, exercises and operations (U.S. Department of Defense, 2016).

Pursuant to the operational strategy report in 2011, the DoD published an implementation plan to integrate operational energy considerations and transformation into existing programs, processes, and institutions (U.S. Department of Defense, 2012). These documents will provide guidance to the DoD in how to better use energy resources and transform the way we power current and future forces.

Training and testing activities within the Study Area would result in an increase in energy demand over the No Action Alternative. The increased energy demand would arise from an increase in fuel consumption, mainly from aircraft and vessels participating in training and testing. Aircraft fuel consumption is estimated to remain fairly consistent across both Action Alternatives. Vessel fuel consumption is estimated to increase by approximately 35 percent per year under Alternative 2, compared to Alternative 1. Conservative assumptions were made in developing the estimates, and therefore the actual amount of fuel consumed during training and testing events may be less than estimated. The alternatives could result in a net cumulative reduction in the global energy (fuel) supply.

Energy requirements would be subject to any established energy efficiency practices. The use of energy sources has been minimized wherever possible without compromising safety, training, or testing activities. No additional efficiency measures related to direct energy consumption by the proposed activities are identified. The Navy's energy vision given in the Operational Energy Strategy report (U.S. Department of Defense, 2016) is consistent with energy conservation practices and states that the Navy values energy as a strategic resource, understands how energy security is fundamental to executing our mission afloat and ashore, and is resilient to any potential energy future.

The Navy is committed to improving energy security and environmental stewardship by reducing its reliance on fossil fuels. The Navy is actively developing and participating in energy, environmental, and climate change initiatives that will help conserve the world's resources for future generations. The Navy Climate Change Roadmap identifies actions the Navy is taking to implement Executive Order 13653, *Preparing the United States for the Impacts of Climate Change*.

Two Navy programs—the Operational Energy Program and the Naval Sea Systems Command's Fleet Readiness, Research and Development Program—are helping the fleet better manage fuel via improved operating procedures and long-term initiatives. The Operational Energy Program encourages the operation of ships in the most efficient manner while conducting their mission and supporting the Navy's efforts to treat energy as a combat enabler. The Naval Sea Systems Command's Fleet Readiness, Research, and Development Program includes the High-Efficiency Heating, Ventilating, and Air Conditioning and the Hybrid Electric Drive for DDG-51 class ships, which are improvements to existing shipboard technologies that will both help with fleet readiness and decrease the ships' energy consumption and greenhouse gas emissions. These initiatives are expected to greatly reduce the consumption of fossil fuels (Section 3.1, Air Quality). Furthermore, to offset the impact of its expected near-term increased fuel demands and achieve its goals to reduce fossil fuel consumption and greenhouse gas emissions, the Navy has launched the first vessels of its "Great Green Fleet in San Diego" (Olson, 2016). The Great Green Fleet was a year-long, Department of the Navy initiative that demonstrated the sea service's efforts to transform its energy use (U.S. Department of the Navy, 2016). The Great Green Fleet's centerpiece was a Carrier Strike Group that deployed on alternative fuels including nuclear power for the carrier, and a blend of advanced biofuel made from beef fat and traditional petroleum for its escort ships (U.S. Department of the Navy, 2016). Throughout 2016, other platforms included ships, aircraft, amphibious and expeditionary forces, and shore installations from the Department of the Navy participated in the Great Green Fleet by using energy efficient systems, operational procedures, and/or alternative fuel during the course of planned mission functions throughout the world (U.S. Department of the Navy, 2016).

This page intentionally left blank.

References

Arrecifes de la Cordillera Natural Reserve. (2009). *Plan de Manejo de la Reserva Natural Arrecifes de la Cordillera, Fajardo*. La Cordillera, Fajardo: Puerto Rico Departamento de Recursos Naturales y Ambientales. Retrieved from https://griffingroups.com/file/download/468169.

Bauer, L. J., M. S. Kendall, and C. F. Jeffrey. (2008). Incidence of marine debris and its relationships with benthic features in Gray's Reef National Marine Sanctuary, Southeast USA. *Marine Pollution Bulletin, 56*(3), 402–413.

Burke, S. (2014). *Statement by Ms. Sharon Burke: Hearing before the Subcommittee on Readiness and Management Support, Senate Armed Services Committe, United States Senate*. Washington, DC: Subcommittee on Readiness and Management Support.

Florida Department of Environmental Protection. (2013). *Rookery Bay National Estuarine Research Reserve Management Plan*. Tallahassee, FL: Florida Department of Environmental Protection, Coastal and Aquatic Managed Areas. Retrieved from http://publicfiles.dep.state.fl.us/cama/plans/aquatic/Rookery_Bay_NERR_Management_Plan.pdf.

Guana Tolomato Matanzas National Estuarine Research Reserve. (2009). *Guana Tolomato Matanzas National Estuarine Research Reserve Management Plan, May 2009–April 2014*. St. Augustine, FL: Florida Department of Environmental Protection, Coastal and Aquatic Managed Areas. Retrieved from http://www.nerrs.noaa.gov/Doc/PDF/Reserve/GTM_MgmtPlan.pdf.

Jacques Cousteau National Estuarine Research Reserve. (2009). *Jacques Cousteau National Estuarine Research Reserve Management Plan 2009–2014*. Tuckerton, NJ: Rutgers The State University of New Jersey. Retrieved from http://www.nerrs.noaa.gov/Doc/PDF/Reserve/JCQ_MgmtPlan.pdf.

Jobos Bay National Estuarine Research Reserve. (2008). *Jobos Bay Estuarine Profile, a National Estuarine Research Reserve*. Retrieved from https://coast.noaa.gov/data/docs/nerrs/Reserves_JOB_SiteProfile.pdf.

Moretzsohn, F., J. A. Sanchez Chavez, and J. W. Tunnell, Jr. (Eds.). (2011). *Stetson Bank*. *GulfBase, Resources Database for Gulf of Mexico Research.* Retrieved from http://www.gulfbase.org/reef/view.php?rid=stetson.

National Marine Fisheries Service. (2011). *First Federal Fishery Management Sites Join the National System of Marine Protected Areas*. Silver Spring, MD: National Oceanic and Atmospheric Administration. Retrieved from http://www.nmfs.noaa.gov/fishnews/2011/02112011.htm.

National Marine Protected Areas Center. (2008). *Framework for the National System of Marine Protected Areas of the United States of America*. Silver Spring, MD: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resource Management.

National Marine Protected Areas Center. (2013). *List of National System Marine Protected Areas*. Silver Spring, MD: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Protected Areas Center.

National Marine Sanctuary Program. (1991). *Flower Garden Banks National Marine Sanctuary Final Environmental Statement/Management Plan*. Silver Spring, MD: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, National Marine Sanctuary Program.

National Marine Sanctuary Program. (1996). *Florida Keys National Marine Sanctuary Final Management Plan/Environmental Impact Statement*. Marathon, FL and Silver Spring, MD: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, National Marine Sanctuary Program.

National Marine Sanctuary Program. (2006). *Gray's Reef National Marine Sanctuary Final Management Plan/Final Environmental Impact Statement*. Savannah, GA: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, National Marine Sanctuary Program.

National Marine Sanctuary Program. (2007a). *Florida Keys National Marine Sanctuary Revised Management Plan*. Key West, FL: National Oceanic and Atmospheric Administration, National Ocean Service, National Marine Sanctuary Program.

National Marine Sanctuary Program. (2007b). *Gerry E. Studds Stellwagen Bank National Marine Sanctuary Condition Report 2007*. Silver Spring, MD: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, National Marine Sanctuary Program.

National Oceanic and Atmospheric Administration. (2009). *Coral Reef Habitat Assessment for U.S. Marine Protected Areas: Commonwealth of Puerto Rico*. Puerto Rico: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service. Retrieved from http://www.coris.noaa.gov/activities/habitat_assessment/puerto_rico.pdf.

National Oceanic and Atmospheric Administration. (2010). *Stellwagen Bank National Marine Sanctuary Final Management Plan and Environmental Assessment*. Silver Spring, MD: National Ocean Service, Office of National Marine Sanctuaries. Retrieved from http://stellwagen.noaa.gov/management/fmp/fmp2010.html.

National Oceanic and Atmospheric Administration Fisheries. (2017). *Magnuson-Stevens Fishery Conservation and Management Act*. Retrieved from https://www.fisheries.noaa.gov/resource/document/magnuson-stevens-fishery-conservation-and-management-act.

National Park Service. (2006a). *Management Policies 2006*. Washington, DC: U.S. Department of the Interior.

National Park Service. (2006b). *NPS Coral Reef Management is Still Evolving*. Retrieved from http://www.nature.nps.gov/water/management.cfm.

National Park Service. (2010). *Salt River Bay National Historic Park and Ecological Preserve Laws and Policies*. St. Croix, U.S. Virgin Islands: National Park Service, U.S. Department of the Interior. Retrieved from http://www.nps.gov/sari/parkmgmt/lawsandpolicies.htm.

National Park Service. (2011a). *Gateway National Recreation Area, Superintendent's Compendium of Designations, Closures, Permit Requirements and Other Restrictions Imposed Under Discretionary Authority*. Staten Island, NY: U.S. Department of the Interior. Retrieved from http://www.nps.gov/gate/parkmgmt/upload/Compendium-2011.pdf.

National Park Service. (2011b). *Assateague Island National Seashore General Management Plan/Environmental Impact Statement*. Berlin, MD: U.S. Department of the Interior. Retrieved from http://www.chincoteague-va.gov/pdf/ASIS_GMP_Alts_Newsletter_July_2011_Screen_View.pdf.

National Park Service. (2014a). *Fire Island National Seashore Superintendent's Compendium*. Patchogue, NY: U.S. Department of the Interior, National Park Service. Retrieved from http://www.nps.gov/fiis/learn/management/upload/2014-FIIS-Supt-s-Compendium-UPDATED-August-2014.pdf.

National Park Service. (2014b). *Canaveral National Seashore Compendium*. Washington, DC: U.S. Department of the Interior, National Park Service. Retrieved from http://www.nps.gov/cana/learn/management/upload/2014-Superintendent-s-Compendium.pdf.

National Park Service. (2014c). *Cumberland Island National Seashore Compendium of Superintendents Orders*. St. Marys, GA: U.S. Department of the Interior, National Park Service. Retrieved from https://www.nps.gov/cuis/learn/management/upload/CUIS_FD_FINAL.pdf.

National Park Service. (2015a). *Boston Harbor Islands National Recreation Area: Park Laws*. Retrieved from https://www.nps.gov/boha/learn/management/lawsandpolicies.htm.

National Park Service. (2015b). *Christiansted National Historic Site: Laws and Policies*. Retrieved from https://www.nps.gov/chri/learn/management/lawsandpolicies.htm.

National Park Service. (2015c). *Cape Lookout National Seashore, Superintendent's Compendium of Designations, Closures, Permit Requirements and Other Restrictions Imposed Under Discretionary Authority*. Washington, DC: U.S. Department of the Interior, National Park Service. Retrieved from https://www.nps.gov/calo/learn/management/upload/2015-CALO-Superintendent-Compendium-FINAL.pdf.

National Park Service. (2016a). *Fort Monroe National Monument: Park Management*. Retrieved from https://www.nps.gov/fomr/learn/management/index.htm.

National Park Service. (2016b). *Cape Hatteras National Seashore, Superintendent's Compendium of Designations, Closures, Permit Requirements and Other Restrictions Imposed Under Discretionary Authority*. Washington, DC: U.S. Department of the Interior, National Park Service. Retrieved from https://www.nps.gov/caha/learn/management/lawsandpolicies.htm.

National Park Service. (2016c). *Cape Cod National Seashore, Superintendent's Compendium of Designations, Closures, Permit Requirements and Other Restrictions Imposed Under Discretionary Authority*. Washington, DC: U.S. Department of the Interior, National Park Service. Retrieved from https://www.nps.gov/caco/learn/management/upload/Cape-Cod-National-Seashore-Compendium-February-2016.pdf.

National Park Service. (2016d). *Padre Island National Seashore, Superintendent's Compendium of Designations, Closures, Permit Requirements and Other Restrictions Imposed Under Discretionary Authority*. Washington, DC: U.S. Department of the Interior, National Park Service. Retrieved from https://www.nps.gov/pais/learn/management/upload/2016-Superintendent-Compendium.pdf.

National Park Service. (2017a). *Colonial National Historic Park: Laws and Policies*. Retrieved from https://www.nps.gov/colo/learn/management/lawsandpolicies.htm.

National Park Service. (2017b). *Gulf Islands National Seashore: Laws and Policies*. Retrieved from https://www.nps.gov/guis/learn/management/lawsandpolicies.htm.

National Park Service. (2017c). *Acadia National Park: Park Rules and Regulations*. Retrieved from https://www.nps.gov/acad/planyourvisit/park-rules-and-regulations.htm.

National Park Service. (2017d). *Code of Federal Regulations Title 36 Timucuan Ecological and Historic Preserve Fort Caroline National Memorial*. Timucuan Ecological and Historic Preserve, FL: National Park Service.

National Park Service. (2017e). *Fort Sumter National Monument Superintendent's Compendium*. Washington, DC: U.S. Department of the Interior, National Park Service.

Office of National Marine Sanctuaries. (2008). *Flower Garden Banks National Marine Sanctuary Condition Report 2008*. Silver Spring, MD: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries.

Office of National Marine Sanctuaries. (2012). *Flower Garden Banks National Marine Sanctuary Final Management Plan*. Silver Spring, MD: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries.

Office of National Marine Sanctuaries. (2013). *Monitor National Marine Sanctuary Final Management Plan and Environmental Assessment*. Silver Spring, MD: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries.

Office of National Marine Sanctuaries. (2014). *Gray's Reef National Marine Sanctuary Final Environmental Assessment for Implementation of the Sanctuary Management Plan and New Regulations*. Silver Spring, MD: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries. Retrieved from http://graysreef.noaa.gov/management/mgmtplan/pdfs/grnms_enviro_assess_07092014.pdf.

Olson, W. (2016). Navy launching first Great Green Fleet next week. *Stars and Stripes*. Retrieved from http://www.stripes.com/news/pacific/navy-launching-first-great-green-fleet-next-week-1.388769.

Tres Palmas de Rincón Marine Reserve. (2009). *Borrador Para Vista Pública - Plan de Manejo de la Reserva Marina de Tres Palmas Rincó*: Puerto Rico Departamento de Recursos Naturales y Ambientales. Retrieved from https://rincon.surfrider.org/wp-content/uploads/2016/02/RMTP-management-plan.pdf.

U.S. Department of Defense. (2012). *Operational Energy Strategy: Implementation Plan*. Washington, DC: Assistant Secretary of Defense for Operational Energy Plans & Programs.

U.S. Department of Defense. (2016). *2016 Operational Energy Strategy*. Washington, DC: U.S. Department of Defense.

U.S. Department of the Navy. (2016). *Great Green Fleet*. Retrieved from http://greenfleet.dodlive.mil/energy/great-green-fleet/.

U.S. Fish and Wildlife Service. (2004). *Eastern Shore of Virginia and Fisherman Island National Wildlife Refuges Comprehensive Conservation Plan*. Hadley, MA. Retrieved from http://www.fws.gov/refuge/Fisherman_Island/what_we_do/finalccp.html.

U.S. Fish and Wildlife Service. (2006a). *Breton National Wildlife Refuge Brochure*. Lacombe, LA: U.S. Department of the Interior, U.S. Fish and Wildlife Service. Retrieved from http://www.fws.gov/southeast/pubs/BretonGeneral.pdf.

U.S. Fish and Wildlife Service. (2006b). *National Wildlife Refuge System Uses*. (603 FW 1). Washington, DC: Refuge Management. Retrieved from *http://www.fws.gov/policy/603fw1.html.*

U.S. Fish and Wildlife Service. (2008). *Welcome to Shell Key National Wildlife Refuge*. Retrieved from http://www.fws.gov/swlarefugecomplex/shellkeys/.

U.S. Fish and Wildlife Service. (2013). *Nomans Land Island National Wildlife Refuge About the Refuge*. Retrieved from http://www.fws.gov/refuge/Nomans_Land_Island/about.html.

U.S. Fish and Wildlife Service. (2014a). *Cape May National Wildlife Refuge Rules and Regulations*. Retrieved from http://www.fws.gov/refuge/Cape_May/visit/rules_and_regulations.html.

U.S. Fish and Wildlife Service. (2014b). *Delta National Wildlife Refuge*. Retrieved from http://www.fws.gov/delta/.

U.S. Fish and Wildlife Service. (2015a). *Key West National Wildlife Refuge Rules and Regulations*. Retrieved from http://www.fws.gov/refuge/Key_West/visit/rules_and_regulations.html.

U.S. Fish and Wildlife Service. (2015b). *Great White Heron National Wildlife Refuge Rules and Regulations*. Retrieved from http://www.fws.gov/refuge/Great_White_Heron/visit/rules_and_regulations.html.

U.S. Fish and Wildlife Service. (2015c). *Cedar Keys National Wildlife Refuge Resource Management*. Retrieved from http://www.fws.gov/refuge/Cedar_Keys/what_we_do/resource_management.html.

U.S. Fish and Wildlife Service. (2015d). *Cape Romain National Wildlife Refuge Rules and Regulations*. Retrieved from http://www.fws.gov/refuge/Cape_Romain/visit/rules_and_regulations.html.

U.S. Fish and Wildlife Service (Cartographer). (2015e). Monomoy National Wildlife Refuge 2015 Closed Areas Map. Retrieved from http://www.fws.gov/uploadedFiles/Monomoy_NWR2015_ClosedAreas.pdf

U.S. Fish and Wildlife Service. (2015f). *Maine Coastal Islands National Wildlife Refuge Rules and Regulations*. Retrieved from http://www.fws.gov/refuge/Maine_Coastal_Islands/visit/rules_and_regulations.html.

U.S. Fish and Wildlife Service. (2015g). *National Key Deer Refuge Rules and Regulations*. Retrieved from http://www.fws.gov/refuge/National_Key_Deer_Refuge/visit/rules_and_regulations.html.

U.S. Fish and Wildlife Service. (2015h). *Lower Suwannee National Wildlife Refuge Plan Your Visit*. Retrieved from http://www.fws.gov/refuge/Lower_Suwannee/visit/plan_your_visit.html.

U.S. Fish and Wildlife Service. (2016a). *Pea Island National Wildlife Refuge Rules and Regulations*. Retrieved from http://www.fws.gov/refuge/Pea_Island/visit/rules_and_regulations.html.

U.S. Fish and Wildlife Service. (2016b). *Plum Tree Island National Wildlife Refuge Rules and Regulations*. Retrieved from http://www.fws.gov/refuge/Plum_Tree_Island/visit/rules_and_regulations.html.

U.S. Fish and Wildlife Service. (2016c). *Chincoteague National Wildlife Refuge Rules and Regulations*. Retrieved from http://www.fws.gov/refuge/Chincoteague/visit/rules_and_regulations.html.

U.S. Fish and Wildlife Service. (2016d). *Ten Thousand Islands National Wildlife Refuge Recreation and Education Opportunities*. Retrieved from http://www.fws.gov/refuges/profiles/recEdMore.cfm?ID=41555.

U.S. Fish and Wildlife Service. (2016e). *St. Marks National Wildlife Refuge Rules and Regulations*. Retrieved from http://www.fws.gov/refuge/St_Marks/visit/rules_and_regulations.html.

U.S. Fish and Wildlife Service. (2016f). *Merritt Island National Wildlife Refuge Rules and Regulations*. Retrieved from https://www.fws.gov/refuge/Merritt_Island/visit/rules_and_regulations.html.

U.S. Fish and Wildlife Service. (2017a). *Great White Heron National Wildlife Refuge*. Big Pine Key, FL: U.S. Fish and Wildlife Service. Retrieved from http://www.fws.gov/southeast/pubs/facts/gwhcon.pdf.

U.S. Fish and Wildlife Service. (2017b). *Chassahowitzka National Wildlife Refuge*. Crystal River, FL: U.S. Department of the Interior, U.S. Fish and Wildlife Service. Retrieved from http://www.fws.gov/southeast/pubs/chasstearsheet.pdf.

U.S. Fish and Wildlife Service. (2017c). *Sandy Point National Wildlife Refuge: Rules and Regulations*. Retrieved from https://www.fws.gov/refuge/Sandy_Point/visit/rules_and_regulations.html.

U.S. Virgin Islands Department of Planning and Natural Resources. (2002). *St. Croix East End Marine Park Management Plan*. U.S. Virgin Islands: U.S. Virgin Islands Department of Planning and Natural Resources, Division of Coastal Zone Management. Retrieved from http://docs.lib.noaa.gov/noaa_documents/CoRIS/STX_East_End-Management_Plan_2002.pdf.

U.S. Virgin Islands Department of Planning and Natural Resources. (2011). *St. Thomas East End Reserves Management Plan*. St. Thomas, U.S. Virgin Islands: U.S. Virgin Islands Department of Planning and Natural Resources. Retrieved from http://www.horsleywitten.com/STEERwatersheds/pdf/managementPlans/STEERManagementPlan/STEER_Management_Plan_Final_low.pd.

Virginia Marine Resources Commission. (2015). *Pertaining to Blue Crab Sanctuaries*. *Chapter 4 VAC 20-752-10 et seq.*, Retrieved from http://www.mrc.state.va.us/regulations/FR752.shtm.

Virginia State Parks. (2017). *Kiptopeke State Park Trail Guide*. Cape Charles, VA: Virginia Department of Conservation and Recreation. Retrieved from http://www.dcr.virginia.gov/state-parks/document/data/trail-guide-kiptopeke.pdf.

Waquoit Bay National Estuarine Research Reserve. (2014). *Waquoit Bay National Estuarine Research Reserve Management Plan 2014–2019, Supporting Coastal Communities through Science*. Waquoit Bay, MA: Massachusetts Department of Conservation and Recreation. Retrieved from http://www.waquoitbayreserve.org/wp-content/uploads/WB-2014-2019-Management-Plan_Final.pdf.

Final
Environmental Impact Statement/Overseas Environmental Impact Statement
Atlantic Fleet Training and Testing

TABLE OF CONTENTS

List of Figures

This section does not contain figures.

List of Tables

This section does not contain tables.

This page intentionally left blank.

7 LIST OF PREPARERS

The Atlantic Fleet Training and Testing Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) was prepared collaboratively between the Navy and contractor staff.

U.S. Department of the Navy

Sarah Bowman (Naval Facilities Engineering Command Atlantic), Environmental Planner
M.E.M., Coastal Environmental Management
B.S., Biology
Years of Experience: 15

Jocelyn Borcuk (Naval Undersea Warfare Center, Division Newport), Biologist/Environmental Planner
B.S., Marine Biology
Years of Experience: 8

Victoria Bowman (Space and Naval Warfare Systems Command), Environmental Scientist
B.A., Psychology
Years of Experience: 7

Laura Busch (United States Fleet Forces Command), Natural and Cultural Resources Program Manager
M.Ag., Rangeland Ecology and Management
M.S., Beef Cattle Science
B.S., Agriculture Economics
Years of Experience: 16

Benjamin Colbert (Naval Sea Systems Command), Environmental Protection Specialist, Environmental Planning Branch
B.S., Organizational Leadership
Years of Experience: 9

Lesley Dobbins-Noble (Naval Facilities Engineering Command Atlantic), NEPA Operations and Range Sustainment Branch Head
M.S., Biology
B.S., Biology
Years of Experience: 19

Amy Farak (United States Fleet Forces Command), Natural Resources Specialist
B.S., Marine Biology
Years of Experience: 17

Nora Gluch (Naval Sea Systems Command), Environmental Management and Policy Division Director
M.E.M., Coastal Environmental Management
B.A., Sociology
Years of Experience: 12

Jaime Gormley (Naval Facilities Engineering Command Atlantic), Marine Resources Specialist
M.E.M., Coastal Environmental Management
B.A., Marine Biology
Years of Experience: 8

Elizabeth Henderson (Space and Naval Warfare Systems Command), Bioacoustic Scientist
Ph.D., Biological Oceanography
M.S., Wildlife and Fisheries Sciences
B.A., Psychobiology
Years of Experience: 20

Peter Hulton (Naval Undersea Warfare Center, Division Newport), Technical Project Manager, Marine Species Modeling Team
B.S., Mechanical Engineering
Years of Experience: 34

Keith Jenkins (Space and Naval Warfare Systems Command), Marine Resources Specialist
M.S., Fisheries Oceanography
B.S., Marine Biology
Years of Experience: 17

Sarah Kotecki (Space and Naval Warfare Systems Command), Engineer
B.S., Civil and Environmental Engineering
Years of Experience: 17

Todd Kraft (United States Fleet Forces Command), Environmental Planner
LLM, International Environmental Law
J.D., Law
B.A., Public Justice and Sociology
Years of Experience: 14

Tara Moll (Naval Undersea Warfare Center, Division Newport), Marine Biologist
M.S., Biological Sciences
B.S., Marine Biology
Years of Experience: 12

Jene Nissen (United States Fleet Forces Command), Acoustics Policy Manager
M.S., Applied Engineering
B.S., Electrical Engineering
Years of Experience: 33

Nicholas Paraskevas (Naval Air Systems Command), Deputy, Environmental and Energy Programs
B.S., Aerospace and Ocean Engineering
Years of Experience: 42

Jennifer Paulk (Naval Air Systems Command), Environmental Scientist
M.S., Physiology
B.S., Psychology
Years of Experience: 21

Kelly Proctor (Naval Facilities Engineering Command Atlantic), Environmental Planner
M.S., Biology
B.S., Biology
Years of Experience: 12

Raymond Soukup (Office of Naval Research), Physicist
M.A., Mathematical Statistics
B.S., Physics
Years of Experience: 29

Greg Thompson (United States Fleet Forces Command), Environmental Planner
M.S., Environmental Science
B.S., Forestry and Wildlife Science
M.B.A.
Years of experience: 24

Contractors

Danny Heilprin (ManTech International), Senior Marine Biologist
M.S., Marine Sciences
B.A., Aquatic Biology
Years of Experience: 31

Taylor Houston (ManTech International), Natural Resource Specialist
B.S., Natural Resource Management
Years of Experience: 17

Cynthia M. LeDoux-Bloom (ManTech International), Senior Marine Biologist
Ph.D., Animal Biology (fish behavior)
M.S., Natural Science (marine fishes)
B.S., Biology (marine emphasis)
Years of experience: 24

Karyn Palma (ManTech International), Technical Editor
B.A., Environmental Studies
Years of Experience: 22

Heather Turner (ManTech International), Marine Biologist
M.A.S., Marine Biodiversity and Conservation
B.S., Environmental Science
Years of Experience: 9

Karen Waller (ManTech International), Senior Environmental Scientist
B.S., Public Affairs
Years of Experience: 27

Brian D. Wauer (ManTech International), Project Manager
B.S., Administrative Management
B.S., Industrial Management
Years of Experience: 32

Lawrence Wolski (ManTech International), Marine Scientist
M.S., Marine Sciences
B.S., Biology
Years of Experience: 19

Mike Zickel (ManTech International), Senior Environmental Scientist
M.S., Marine Estuarine Environmental Sciences
B.S., Physics
Years of Experience: 19

Brad Boykin (Leidos, Inc.), Environmental Scientist
M.S., Biotechnology
B.S., Biomedical Science
Years of Experience: 13

Janet Clarke, (Leidos, Inc.), Research Biologist
M.A., Anthropology
B.S., Wildlife Management
Years of Experience: 34

Ronald Combs (Leidos, Inc.), Senior Environmental Scientist
M.S., Biology
B.S., Biology
B.S., Business Administration
Years of Experience: 16

Luis Diaz, (Leidos, Inc.), Environmental Engineer
M.E., Environmental Engineering
B.S., Aerospace Engineering
Years of Experience: 21

Vicky Frank (Leidos, Inc.), Senior Environmental Scientist
B.A., General Biology/Cell Biology
Years of Experience: 29

Karen Green (Leidos, Inc.), Senior Environmental Scientist
M.S., Biology
B.S., Marine Biology
Years of Experience: 32

Meike Holst (LGL Limited, Environmental Research Associates), Marine Ecologist
M.Sc., Environmental Biology and Ecology
B.Sc., Zoology
Years of Experience: 16

Jamie McKee (Leidos, Inc.), Senior Project Manager
B.S., Marine Biology
Years of Experience: 33

Mike Nation (Leidos, Inc.), GIS Data Analyst
B.S., Environmental Science/Policy
Years of Experience: 16

Tara Utsey (Leidos), Senior Publication Specialist
B.A., Liberal Arts
Years of Experience: 25

Jennifer Combs (Leidos), Senior Copyeditor
B.S., Communications, Journalism
Years of Experience: 29

Carl Nielsen (ESS Group, Inc.), Principal Benthic Ecologist
M.S., Fisheries and Wildlife
B.A., Biology
Years of Experience: 26

Amanda Robydek (Leidos, Inc.), Marine Scientist
B.S., Environmental Science
Years of Experience: 9

Bernice Tannenbaum (Leidos, Inc.), Senior Environmental Scientist
Ph.D., Animal Behavior
B.S., Zoology
Years of Experience: 36

Carmen Ward (Leidos, Inc.), Program Manager
M.S., Environmental Engineering
B.S., Chemical Engineering
Years of Experience: 27

Stephanie Wilson (ESS Group, Inc.), Senior Marine Biologist
M.S., Marine Biology (Fisheries)
B.S., Marine and Freshwater Biology, Statistics Minor
Years of Experience: 20

Lewis Albee (Cardno), Program Manager
M.S., Limnology
B.A., Biology
Years of Experience: 27

Stephen Anderson (Cardno), Environmental Scientist
B.A., Environmental Science
Years of Experience: 8

Blake Claypool (Cardno), Environmental Scientist
B.S., Biology
Years of Experience: 18

Michael Dungan, (Cardno), Senior Ecologist
Ph.D., Ecology and Evolutionary Biology
B.A., Zoology
Years of Experience: 36

Lesley Hamilton (Cardno), Senior Air Quality Specialist
B.A., Chemistry
Years of Experience: 29

Michael Harrison (Cardno), Environmental Scientist
M.S., Environmental Science
B.S., Biology
Years of Experience: 13

SunTemple Helgren (Cardno), Senior Project Manager
B.S., Geography, Environmental Studies Concentration
Years of Experience: 22

John Lowenthal (Cardno), Biologist
M.S., Plant Ecology
B.S., Biology
Years of Experience: 31

Kevin Martin (Cardno), Senior Environmental Planner
M.P., Urban and Environmental Planning
B.A., Economics
Years of Experience: 23

Christopher Noddings (Cardno), Biologist
M.S., Environmental Science and Management
B.A., Environmental Systems
Years of Experience: 13

Amy Paulson (Cardno), Environmental Planner
M.S., Conservation and Sustainable Development
B.S., Biology
Years of Experience: 21

Clint Scheuerman (Cardno), Environmental Scientist
M.A., Biological Sciences
B.S., Biological Sciences
Years of Experience: 14

Sharon Simpson (Cardno), Project Coordinator
A.S., Science
Years of Experience: 14

Robert Wardwell (Cardno), Quality Control Manager
M.S., Environmental Science
M.B.A., Transportation/Logistics
B.A., Economics
Years of Experience: 41

Kimberly Wilson (Cardno), Document Production Manager
Years of Experience: 31

Sarah Rider (G2 Software Systems), Marine Resources Specialist

M.E.M., Coastal Environmental Management

B.S., Marine Science

Years of Experience: 11

Cameron Martin (National Marine Mammal Foundation), Environmental Scientist

B.S., Environmental Science

Years of Experience: 4

Michelle Tishler (National Marine Mammal Foundation), Marine Resources Specialist

M.S., Marine Biology

B.S., Wildlife Ecology and Conservation, Fisheries and Aquatic Sciences Minor

Years of Experience: 9

Ashley Kelly (SAIC), Natural Resources Support

M.Phil., Human Ecology, Marine Mammal Ecology and Behavior

B.S., Marine Biology

Years of Experience: 6

This page intentionally left blank.

Final
Environmental Impact Statement/Overseas Environmental Impact Statement
Atlantic Fleet Training and Testing

TABLE OF CONTENTS

List of Figures

List of Tables

(This page intentionally left blank)

8 PUBLIC INVOLVEMENT AND DISTRIBUTION

This chapter describes the efforts to involve the public in preparing the Atlantic Fleet Training and Testing (AFTT) Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS), including distribution of the Draft EIS/OEIS.

8.1 Project Website

A public website was established for this project: www.AFTTEIS.com. This website address was published in the *Notice of Intent to Prepare an Environmental Impact Statement/Overseas Environmental Impact Statement* (Appendix G, Federal Register Notices). It was subsequently reprinted in newspaper advertisements, agency letters, a subscribers email release, and postcards for the Notice of Intent. The scoping meeting fact sheets, public meeting fact sheets, technical reports, and various other materials are available on the project website and will be made available throughout the course of the project.

8.2 Scoping Period

The public scoping period began with issuance of the Notice of Intent in the *Federal Register* on November 12, 2015 (see Appendix G, Federal Register Notices). This notice included a project description, website address, and instructions on how to provide comments. A corrected Notice of Intent was issued on December 1, 2015 correcting an error in the comment deadline date and telephone number. The scoping period lasted 60 days, concluding on January 12, 2016. The public was provided a variety of methods to comment on the scope of the EIS/OEIS during the scoping period.

8.2.1 Public Scoping Notification

The U.S. Department of the Navy (Navy) made significant efforts to notify the public to ensure maximum public participation during the scoping process. A summary of these efforts follows.

8.2.1.1 Notification Letters

Notice of Intent and Scoping Notification letters were distributed at the beginning of the scoping period (November 12, 2015) to federally-recognized tribes; state elected officials; and federal, regional, and state agencies. Entities that received the Scoping Notification letter can be found in Table 8.2-1 and an example of the letter can be found in .

Table 8.2-1: Entities that Received the Scoping Notification Letter

Federally-Recognized Tribes	
Alabama-Coushatta Tribes of Texas	Narragansett Indian Tribe of Rhode Island
Aroostook Band of Micmac Indians of Maine	Oneida Nation of New York
Catawba Indian Nation	Onondaga Nation of New York
Cayuga Nation of New York	Passamaquoddy Tribe – Indian Township Reservation
Chitimacha Tribe of Louisiana	Penobscot Tribe of Maine
Coushatta Tribe of Louisiana	Poarch Band of Creek Indians of Alabama
Eastern Band of Cherokee Indians of North Carolina	Saint Regis Mohawk Tribe, New York
Jena Band of Choctaw Indians	Seminole Tribe of Florida
Kickapoo Traditional Tribe of Texas	Seneca Nation of New York
Mashantucket Pequot Tribe of Connecticut	Tonawanda Band of Seneca Indians of New York
Mashpee Wampanoag Tribe, Massachusetts	Tunica-Biloxi Indian Tribe of Louisiana
Miccosukee Tribe of Indians of Florida	Tuscarora Nation of New York
Mississippi Band of Choctaw Indians, Mississippi	Wampanoag Tribe of Gay Head of Massachusetts
Mohegan Indian Tribe of Connecticut	Ysleta del Sur Pueblo of Texas

Table 8.2-1: Entities that Received the Scoping Notification Letter (continued)

Alabama		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Alabama Department of Agriculture and Industries Alabama Department of Conservation and Natural Resources Alabama Department of Economic and Community Affairs Alabama Department of Environmental Management Alabama Development Office Alabama Historical Commission	Baldwin County City of Mobile County of Mobile Bay County Brevard County
Connecticut		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Connecticut Council on Environmental Quality Connecticut Department of Economic and Community Development Connecticut Department of Energy and Environmental Protection Connecticut Department of Public Health	City of New London Town of Groton
Delaware		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Delaware Division of Historical and Cultural Affairs Delaware Economic Development Office Delaware Heritage Commission Delaware River Basin Commission Delaware Office of Management and Budget: Budget Development, Planning, and Administration Department of Natural Resources and Environmental Control	
Florida		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Florida Department of Environmental Protection Florida Fish and Wildlife Conservation Commission Florida Fish and Wildlife Conservation Commission: Office of Environmental Services Florida State Clearinghouse	Bay County Brevard County Cape Canaveral Port Authority City of Atlantic Beach City of Cape Canaveral City of Dania Beach City of Jacksonville City of Key West City of Milton City of Pensacola County of Escambia Jacksonville Port Authority Monroe County Panama City Panama City Beach Panama City Port Authority Port Canaveral Santa Rosa County

Table 8.2-1: Entities that Received the Scoping Notification Letter (continued)

Georgia		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Georgia Department of Economic Development Georgia Department of Natural Resources Georgia Environmental Facilities Authority Georgia Forestry Commission Georgia State Clearinghouse	City of Kingsland City of St. Mary's City of Woodbine County of Camden
Louisiana		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Louisiana Department of Culture, Recreation, and Tourism Louisiana Department of Economic Development Louisiana Department of Environmental Quality Louisiana Department of Natural Resources Louisiana State Military Department	City of New Orleans
Maine		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Historic Preservation Commission Maine Department of Conservation Maine Department of Environmental Protection Maine Department of Inland Fisheries and Wildlife Maine State Planning Office	City of Bath City of Portland Cumberland County Town of Kittery
Maryland		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Maryland Department of Environment Maryland Department of Natural Resources Maryland Department of Agriculture Maryland Department of Business and Economic Development Maryland Economic Development Corporation Maryland State Clearinghouse for Intergovernmental Assistance	Town of Ocean City Somerset County Wicomico County Worcester County

Table 8.2-1: Entities that Received the Scoping Notification Letter (continued)

Massachusetts		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Cape Cod Commission Central Massachusetts Regional Planning Commission Franklin Regional Council of Governments Massachusetts Department of Conservation and Recreation Massachusetts Department of Environmental Protection Massachusetts Department of Public Health Massachusetts Executive Office of Health and Human Services Massachusetts Port Authority Massachusetts Regional Planning Commission Massachusetts Water Resources Authority Merrimack Valley Planning Commission	City of Boston Town of Barnstable
Mississippi		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Mississippi Department of Environmental Quality Mississippi Department of Finance and Administration Mississippi Department of Marine Resources, Coastal Management and Planning Mississippi Soil and Water Conservation Commission Mississippi State Port Authority	City of Meridian City of Moss Point City of Pascagoula Harrison County Jackson County Port of Pascagoula
New Hampshire		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	New Hampshire Department of Cultural Resources New Hampshire Department of Environmental Services New Hampshire Department of Resources and Economic Development New Hampshire Department of Safety New Hampshire Division of Forests and Lands New Hampshire Fish and Game Department New Hampshire Office of Energy and Planning State of New Hampshire Economic Development	City of Portsmouth Rockingham County

Table 8.2-1: Entities that Received the Scoping Notification Letter (continued)

New Jersey		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Garden State Preservation Trust New Jersey Department of Agriculture New Jersey Department of Environmental Protection New Jersey Department of Environmental Protection: Office of Permit Coordination and Environmental Review New Jersey Economic Development Authority New Jersey Historic Trust	Atlantic County Ocean County
New York		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	New York State Department of Environmental Conservation	Long Island, Nassau County Long Island, Suffolk County
North Carolina		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	North Carolina Department of Administration North Carolina Department of Administration: State Environmental Review Clearinghouse North Carolina Department of Cultural Resources North Carolina Department of Environment and Natural Resources North Carolina Division of Parks and Recreation North Carolina Division of Water Quality North Carolina Economic Developers Association North Carolina State Ports Authority North Carolina Wildlife Resources Commission North Carolina's Southeast Economic Development Organization	City of Havelock City of Jacksonville City of Wilmington County of Carteret County of Craven County of Jones County of Pamlico County Of Pender Morehead City Onslow County Town of Nags Head
Rhode Island		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Rhode Island Coastal Resources Management Council Rhode Island Department of Administration Rhode Island Department of Environmental Management Rhode Island Department of Health Rhode Island Division of Planning	City of Newport

Table 8.2-1: Entities that Received the Scoping Notification Letter (continued)

South Carolina		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Department of Natural Resources Office of State Budget South Carolina Department of Agriculture South Carolina Department of Health and Environmental Control South Carolina Department of Parks, Recreation, and Tourism South Carolina Sea Grant Consortium	City of Charleston
Texas		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Texas Bureau of Economic Geology Texas Commission on Environmental Quality Texas General Land Office Texas Parks and Wildlife Department Texas State Grants Team	City of Corpus Christi County of Kleberg County of Nueces County of San Patricio
Virginia		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Chesapeake Bay Commission Virginia Department of Conservation and Recreation Virginia Department of Environmental Quality Virginia Department of Forestry Virginia Department of Game and Inland Fisheries Virginia Department of Historic Resources Virginia Department of Natural Resources Virginia Department of Planning and Budget Virginia Department of Transportation Virginia Marine Resources Commission Virginia Port Authority Virginia Resources Authority	City of Newport News City of Norfolk City of Portsmouth City of Virginia Beach County of Accomack Town of Chincoteague

Table 8.2-1: Entities that Received the Scoping Notification Letter (continued)

Regional
Federal Agencies
Federal Aviation Administration, Eastern Region
Federal Aviation Administration, Southern Region
Federal Aviation Administration, Southwest Region
Fishery Management Council, Caribbean
Fishery Management Council, Gulf of Mexico
Fishery Management Council, Mid-Atlantic
Fishery Management Council, New England
Fishery Management Council, South Atlantic
Gulf State Marine Fisheries Commission
National Marine Fisheries Service, West Palm Beach Field Office
U.S. Army Corps of Engineers, Baltimore District
U.S. Army Corps of Engineers, Galveston District
U.S. Army Corps of Engineers, Jacksonville District
U.S. Army Corps of Engineers, Jacksonville District, West Palm Beach Office
U.S. Army Corps of Engineers, Mobile District
U.S. Army Corps of Engineers, New England District
U.S. Army Corps of Engineers, New Orleans District
U.S. Army Corps of Engineers, New York District
U.S. Army Corps of Engineers, Norfolk District
U.S. Army Corps of Engineers, Philadelphia District
U.S. Army Corps of Engineers, Wilmington District
U.S. Coast Guard, District 1
U.S. Coast Guard, District 5
U.S. Coast Guard, District 7
U.S. Coast Guard, District 8
U.S. Coast Guard, District 9

8.2.1.2 Postcard Mailers

On November 12, 2015, postcards were mailed to 647 recipients on the project mailing list, including individuals, nonprofit organizations, and for-profit organizations. The postcards provided information on the Proposed Action, methods for commenting, and the project website address to obtain more information. An example of the postcard is shown in Figure 8.2-2 and Figure 8.2-3

DEPARTMENT OF THE NAVY
COMMANDER
1562 MITSCHER AVE, SUITE 250
U.S. FLEET FORCES COMMAND
NORFOLK, VA 23551-2487

5090
Ser N46/114
November 12, 2015

Dear Sir or Madam:

This letter is to inform you that the United States (U.S.) Department of the Navy (Navy) is in the beginning stages of preparing an Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) for Atlantic Fleet Training and Testing (AFTT) activities in the seaspace in and the airspace over the Atlantic Ocean and the eastern coast of North America, portions of the Caribbean Sea, and the Gulf of Mexico.

The U.S. Navy is requesting your comments on the scope, content, and issues to be considered during the development of the AFTT EIS/OEIS. This document will assess training and testing activities which are proposed to be conducted at levels required to support military readiness requirements beginning in November of 2018 and into the reasonably foreseeable future. Such activities will also accommodate evolving mission requirements associated with force structure changes, including those resulting from the development, testing, and ultimate introduction of new platforms (vessels, aircraft, and weapon systems) into the fleet, thereby ensuring critical Navy requirements are met.

The purpose of the Proposed Action is to maintain a ready force, which is needed to ensure that the Navy can meet its mission to maintain, train, and equip combat-ready naval forces capable of winning wars, deterring aggression, and maintaining freedom of the seas, as consistent with Congressional direction in Section 5062 of Title 10 U.S. Code.

You may send written comments to the following address:

Naval Facilities Engineering Command Atlantic
ATTN: AFTT EIS/OEIS PM – Code EV22LDN
6506 Hampton Boulevard
Norfolk, Virginia 23508-1278

You may also submit comments on the project website at www.aftteis.com. All comments must be postmarked or received by January 12, 2016 to be considered in the Draft EIS/OEIS. For additional information about the AFTT EIS/OEIS, please visit the project website.

Figure 8.2-1: Stakeholder Scoping Notification Letter

5090
Ser N46/114
November 12, 2015

We appreciate your comments on this important project. My point of contact for this matter is Mr. Todd Kraft at (757) 836-2943 or todd.kraft@navy.mil.

Sincerely,

B. B. McCUTCHEON, JR.
Acting
Deputy Chief of Staff
for Fleet Installations
and Environmental Readiness

Enclosures: 1. AFTT EIS/OEIS Project Description
2. AFTT Study Area Map

2

Figure 8.2-1: Stakeholder Scoping Notification Letter (continued)

ATLANTIC FLEET TRAINING AND TESTING (AFTT)

ENVIRONMENTAL IMPACT STATEMENT/OVERSEAS ENVIRONMENTAL IMPACT STATEMENT (EIS/OEIS)

PROJECT DESCRIPTION AND STUDY AREA MAP

AFTT EIS/OEIS Proposed Action and Alternatives:

The U.S. Navy's Proposed Action is to conduct military readiness training and testing activities in the AFTT Study Area. These activities are proposed to be conducted at levels necessary to support Navy military readiness requirements beginning in November 2018 into the reasonably foreseeable future and accommodate evolving mission requirements associated with force structure changes resulting from the development, testing, and ultimate introduction of new platforms (vessels, aircraft, and weapon systems) into the fleet, thereby ensuring critical Navy requirements are met.

The Navy has conducted previous analyses for these types of activities in the AFTT Study Area and signed a Record of Decision in November of 2013. This new AFTT EIS/OEIS will analyze the continuation of military readiness activities in the AFTT Study Area into the reasonably foreseeable future. The AFTT EIS/OEIS will consider a No Action Alternative and action alternatives that account for types and tempo of training and testing activities beginning in November of 2018 as necessary to meet future readiness requirements.

Environmental Analysis:

Resource areas that will be addressed include, but are not limited to: biological resources (including marine mammals and threatened and endangered species), sediments and water quality, air quality, noise, cultural resources, socioeconomic resources, and public health and safety.

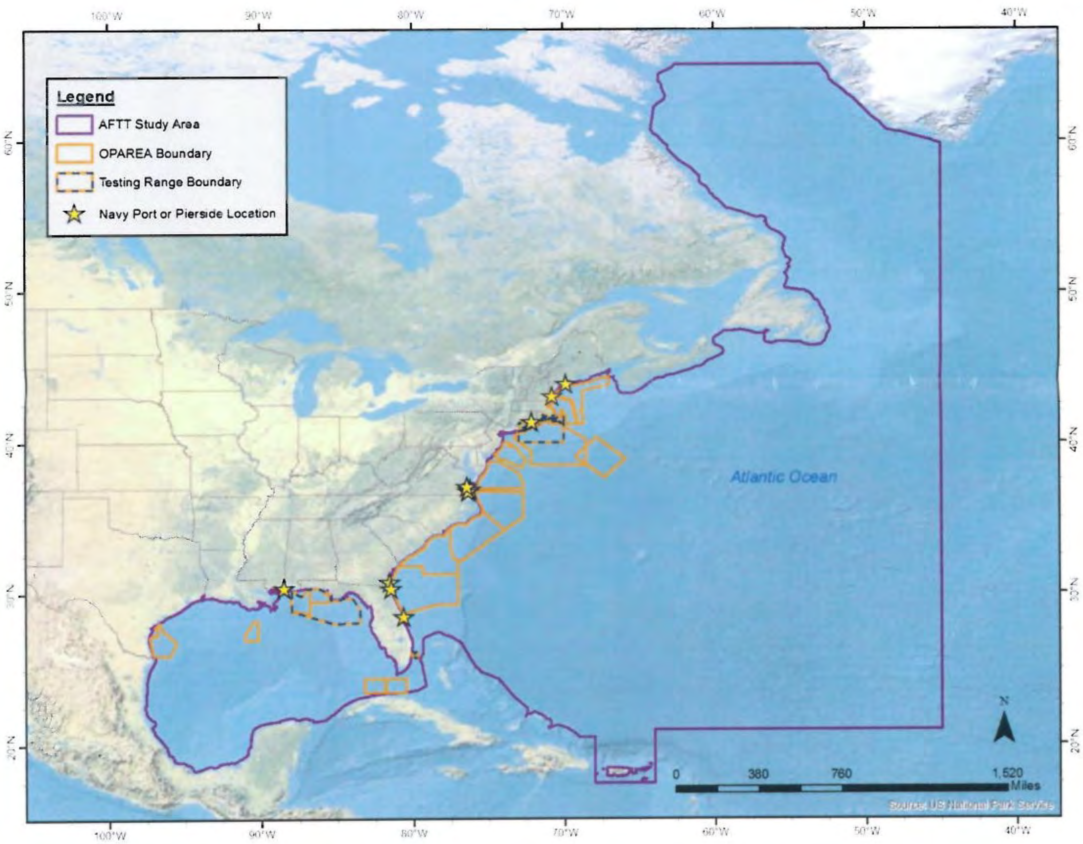
AFTT Study Area:

The Study Area consists of seaspace in and airspace over the Atlantic Ocean along the eastern coast of North America, portions of the Caribbean Sea, and the Gulf of Mexico. The AFTT Study Area begins seaward from the mean high water line and moves east to the 45-degree west longitude line, north to the 65-degree north latitude line, and south to the approximately 20-degree north latitude line. The Study Area covers approximately 2.6 million square nautical miles of ocean area, including designated Navy operating areas, testing ranges, warning areas, select Navy pierside locations, and associated port transit channels.

Enclosure (1)

Figure 8.2-1: Stakeholder Scoping Notification Letter (continued)

ATLANTIC FLEET TRAINING AND TESTING (AFTT) STUDY AREA



Enclosure (2)

Figure 8.2-1: Stakeholder Scoping Notification Letter (continued)

Figure 8.2-2: Postcard Mailer for Scoping (front)

Proposed Action

The Navy proposes to continue conducting training and testing activities within Navy ranges in the Study Area, including the use of active sonar and explosives. Proposed activities are similar to the types of activities that have been occurring for decades in the Study Area. The Navy follows strict guidelines and employs protective measures while training and testing to reduce effects on marine species.

The Proposed Action is needed to accomplish the Navy mission to maintain, train and equip combat-ready naval forces capable of winning wars, deterring aggression and maintaining freedom of the seas.

Naval Facilities Engineering
Command Atlantic
Attention: AFTT EIS/OEIS
Project Manager
Code: EV22LDN
6506 Hampton Blvd.
Norfolk, VA 23508-1278

Figure 8.2-3: Postcard Mailer for Scoping (back)

8.2.1.3 Newspaper Advertisements

To announce the scoping period, advertisements were placed in the listed newspapers in the following cities on the dates indicated in Table 8.2-2. The advertisements included a description of the Proposed Action, the address of the project website, the duration of the comment period, and information on how to provide comments. An example of the advertisement is shown in Figure 8.2-4.

Table 8.2-2: Newspaper Announcements of Scoping Period

Portland, ME *The Portland Press Herald* November 13, 2015 November 14, 2015 November 15, 2015	**Cumberland and Sagadahoc Counties, ME** *The Times Record* November 13, 2015 November 16, 2015 November 17, 2015	**New Bedford, MA** *The Standard Times* November 13, 2015 November 14, 2015 November 15, 2015
Boston, MA *The Boston Herald* November 13, 2015 November 14, 2015 November 15, 2015	**Providence, RI** *The Providence Journal* November 13, 2015 November 14, 2015 November 15, 2015	**Newport, RI** *The Newport Daily News* November 13, 2015 November 14-15, 2015 November 16, 2015
Salisbury, MD *The Daily Times* November 13, 2015 November 14, 2015 November 15, 2015	**Norfolk, VA** *The Virginia Pilot* November 13, 2015 November 14, 2015 November 15, 2015	**Newport News, VA** *The Daily Press* November 13, 2015 November 14, 2015 November 15, 2015
Nags Head, NC *Outer Banks Sentinel* November 13, 2015	**Jacksonville, NC** *Jacksonville Daily News* November 13, 2015 November 14, 2015 November 15, 2015	**Wilmington, NC** *Wilmington Star News* November 13, 2015 November 14, 2015 November 15, 2015
Charleston, SC *Charleston Post and Courier* November 13, 2015 November 14, 2015 November 15, 2015	**Savannah, GA** *Savannah Morning News* November 13, 2015 November 14, 2015 November 15, 2015	**Jacksonville, FL** *Florida Times Union* November 13, 2015 November 14, 2015 November 15, 2015
Fort Lauderdale, FL *Florida Sun Sentinel* November 13, 2015 November 14, 2015 November 15, 2015	**Brevard, FL** *Florida Today* November 13, 2015 November 14, 2015 November 15, 2015	**Panama City, Bay County, FL** *The News Herald* November 13, 2015 November 14, 2015 November 15, 2015
Pensacola, FL *Pensacola News Journal* November 13, 2015 November 14, 2015 November 15, 2015	**New Orleans, LA** *Times-Picayune* November 13, 2015 November 15, 2015 November 18, 2015	**Galveston, TX** *Galveston Daily News* November 13, 2015 November 14, 2015 November 15, 2015
Corpus Christi, TX *Caller-Times* November 13, 2015 November 14, 2015 November 15, 2015	**Pascagoula, MS** *The Mississippi Press* November 13, 2015 November 14, 2015 November 15, 2015	

The U.S. Navy INVITES YOU TO PARTICIPATE In the Atlantic Fleet Training and Testing Environmental Impact Statement

The U.S. Navy is in the early stages of preparing an Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) to evaluate the potential environmental effects associated with military readiness activities, which include training and research, development, testing, and evaluation activities conducted within the Atlantic Fleet Training and Testing (AFTT) Study Area. An EIS/OEIS for AFTT was completed for similar activities in August 2013; this new AFTT document will support future military readiness activities in the AFTT Study Area, which includes the western North Atlantic Ocean along the east coast of North America, the lower Chesapeake Bay, portions of the Caribbean Sea, the Gulf of Mexico, and select pierside locations and their access channels.

The Navy invites comments on identifying the scope of issues to be addressed.

You can participate in a variety of ways:

- Visit the project website, www.AFTTEIS.com, to learn more about Navy at-sea training and testing activities and to provide comments;
- Mail written comments to the address listed below

PROPOSED ACTION

The Navy proposes to continue training and testing in the AFTT Study Area. The purpose of the Proposed Action is to ensure that the Navy maintains a combat-ready force capable of winning wars, deterring aggression, and maintaining freedom of the seas.

SUBMIT WRITTEN COMMENTS TO

Naval Facilities Engineering Command, Atlantic
Attention Code: EV22LDN (AFTT EIS/OEIS Project Manager)
6506 Hampton Boulevard, Norfolk, Virginia, 23508-1278

Provide electronic comments at www.AFTTEIS.com no later than January 12, 2016.

Written comments must be postmarked no later than January 12, 2016.

Figure 8.2-4: Newspaper Announcement of Scoping

8.2.2 Project Video

A project video was developed to support the scoping phase and provide information to the public on the types of training and testing the Navy conducts and its importance. The project video was uploaded to the project website. Topics in the project video included:

- general project overview
- Navy's mission
- importance of training and testing in the AFTT Study Area
- importance of training and testing with sonar and explosives
- existing marine mitigation measures
- environmental stewardship programs

8.2.3 Public Scoping Comments

The scoping comments could be submitted via the project website or by mail. The Navy received comments from federal agencies, state agencies, nongovernmental organizations, individuals and community groups. A total of 72 scoping comments were received and considered during preparation of the AFTT EIS/OEIS. The comments requested the Navy analyze environmental issues for physical and biological resources, such as sonar impacts on marine mammals, to human resources, such as public health and safety. A sampling of some of the specific concerns follows.

8.2.3.1 A True No Action Alternative Analysis

Comments stated that the EIS/OEIS should have a true No Action Alternative in which Navy training and testing activities would cease to occur in the AFTT Study Area and include an analysis of these true No Action Alternative impacts on marine biota, air quality, water quality, socioeconomics, cultural resources, and human health and safety.

The AFTT EIS/OEIS analyzes a No Action Alternative where the Navy would not conduct the proposed training and testing activities in the AFTT Study Area.

8.2.3.2 Time-Area Management and Mitigation Areas

Comments stated that the EIS/OEIS should have reasonable alternatives that incorporate mitigation measures such as time-area management, which would mitigate impacts of noise and other disturbances to marine mammals and sea turtles as activities would happen selectively to allow for areas to sometimes be closed for conservation. Areas of concern include areas identified by the National Marine Fisheries Service as important to marine species, including Cape Hatteras Special Research Area, Cul de Sac, Great Bahama Canyon, Mississippi Canyon, and Sperm Whale habitat west of the Florida Keys and Tortugas.

Chapter 5 (Mitigation), describes the mitigation measures that the Navy will implement to avoid or reduce potential impacts from the AFTT EIS/OEIS Proposed Action.

8.2.3.3 Cumulative Impact Analysis

Comments expressed concern over cumulative impacts to marine biota in the AFTT Study Area and suggest that the Navy develop and implement a long-term monitoring program to assess potential cumulative impacts of AFTT activities on marine animals and their habitat.

All potential cumulative impacts on marine animals and their habitats are identified and addressed in Chapter 4 (Cumulative Impacts) of this EIS/OEIS. Chapter 5 (Mitigation) includes discussion of the Navy's marine species monitoring programs.

8.2.3.4 Range of Alternatives

Comments expressed support for studying a wider range of alternatives and suggested the Navy develop alternatives that consider time and geographic restrictions, specifically during nesting and migration seasons.

The Navy analyzed two action Alternatives and a No Action Alternative which are detailed in Chapter 2 (Description of Proposed Action and Alternatives). The practicability of time and geographic restrictions are discussed in Chapter 5 (Mitigation).

8.2.3.5 Impacts of Training and Testing to Marine Mammals

Comments stated that impacts of training and testing on marine mammals are of great concern and need to be addressed in the EIS/OEIS. Ship strikes to fin whales and other species in the AFTT Study Area could be mitigated by a reduction in ship speed at times or in areas that have a high density of species present. The Navy Acoustic Effects Model is too general and should do more to reduce takes on local species. Impacts of dipping sonar should be more extensively studied and analyzed for marine mammals. Signal modification should be considered to reduce the takes of marine mammals. The Proposed Action should comply with the Marine Mammal Protection Act and the Endangered Species Act. Vessel noise should be added to acoustic impacts in the marine mammal analysis. Impacts from the current and potential increase in use of Navy sonar on whales, especially endangered or threatened species such as the North Atlantic Right Whale, Bryde's Whales, and Sperm Whale. Also, there were concerns expressed about the effect of sonar and explosives on marine mammals resulting in strandings and death.

The Navy does comply with the Marine Mammal Protection Act and the Endangered Species Act. All potential impacts to marine mammals from the Navy's proposed training and testing activities are analyzed in the AFTT EIS/OEIS. Section 3.7 (Marine Mammals) details the potential impacts to marine mammals, including takes. Appendix E (Estimated Marine Mammals and Sea Turtle Impacts from Exposures to Acoustic and Explosive Stressors Under Navy Training and Testing Activities), provides the estimated number of marine mammal and sea turtle impacts resulting from the proposed activities. Specifically, estimated impacts are derived from the quantitative analysis for activities under Alternatives 1 and 2 that involve the use of acoustic or explosive stressors. The quantitative analysis takes into account Navy activities, marine species density layers, acoustic modeling and other environmental parameters.

8.2.3.6 Impacts of Training and Testing to Marine Life

Comments were critical of current Navy sonar and explosives testing and training and expressed concern over impacts to sea turtles, fish (Atlantic sturgeon), and birds. There was an overall concern about the impacts on marine habitat, ecosystems, and wildlife from training and testing activities as well as the increased impacts on already sensitive marine and coastal species.

The impacts to marine life resulting from the proposed training and testing activities are detailed in the Chapter 3 resource sections. Chapter 4 (Cumulative Impacts), discusses the additional effects the Proposed Action may have on already sensitive species.

8.3 Notification of Availability of Draft Environmental Impact Statement/Overseas Environmental Impact Statement

The public comment period on the Draft AFTT EIS/OEIS began with the issuance of the Notice of Availability and a Notice of Public Meetings in the Federal Register on 30 June 2017. A correction of the Notice of Availability was issued on 7 July 2017 (Appendix G; Federal Register Notices). The Federal Register notices included notification of the availability of the Draft EIS/OEIS and where it can be accessed; an overview of the Proposed Action and its purpose and need; public commenting information; and the locations, dates, and times of public meetings. The purpose of the public meetings was to inform the public about the Proposed Action and to solicit public comments on the environmental issues addressed and analyzed in the Draft EIS/OEIS. The Draft EIS/OEIS public review and comment period lasted 60 days, concluding on 29 August 2017. Comments were accepted by mail, through the EIS/OEIS website at: www.AFTTEIS.com, and at the public meetings.

8.3.1 Notification of Draft Environmental Impact Statement/Overseas Environmental Impact Statement and Public Meetings

The Navy made significant efforts to distribute information about the project and notify the public to ensure maximum public participation during the public comment period. A summary of these efforts follows.

8.3.1.1 Notification Letters

Letters were sent to federally-recognized tribes; state elected officials; and federal, regional, and state agencies. The letters provided a description of the Proposed Action, address of the project website, duration of the comment period, and information on the public meetings. A stakeholder notification letter was distributed on the day of the release of the Draft EIS/OEIS to appropriate and interested federal, state, and local government agencies, nongovernmental organizations, and persons expressing an interest in the Proposed Action and Draft EIS/OEIS. A total of 1,340 stakeholder notification letters were mailed. Entities that received the notification letters are listed in Table 8.3-1. Figure 8.3-1 provides an example letter.

Table 8.3-1: Entities that Received the Draft Environmental Impact Statement/Overseas Environmental Impact Notification Letter

Federally-Recognized Tribes	
Absentee Shawnee Tribe of Indians of Oklahoma Alabama-Coushatta Tribes of Texas Aroostook Band of Micmac Indians of Maine Catawba Indian Nation Cayuga Nation of New York Chitimacha Tribe of Louisiana Coushatta Tribe of Louisiana Delaware Nation Delaware Tribe of Indians Eastern Band of Cherokee Indians of North Carolina Houlton Band of Maliseet Indians Jena Band of Choctaw Indians Kickapoo Traditional Tribe of Texas Mashantucket Pequot Tribe of Connecticut Mashpee Wampanoag Tribe, Massachusetts Miccosukee Tribe of Indians of Florida Mississippi Band of Choctaw Indians, Mississippi Mohegan Indian Tribe of Connecticut	Narragansett Indian Tribe of Rhode Island Oneida Nation of New York Onondaga Nation of New York Passamaquoddy Tribe – Indian Township Reservation Passamaquoddy Tribe at Pleasant Point Reservation Penobscot Tribe of Maine Poarch Band of Creek Indians of Alabama Saint Regis Mohawk Tribe, New York Seminole Tribe of Florida Seneca Nation of Indians Shawnee Tribe of Oklahoma Shinnecock Indian Nation Stockbridge-Munsee Band of the Mohicans Tonawanda Band of Seneca Indians of New York Tunica-Biloxi Indian Tribe of Louisiana Tuscarora Nation of New York Wampanoag Tribe of Gay Head of Massachusetts Ysleta del Sur Pueblo of Texas

State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Alabama Department of Agriculture and Industries Alabama Department of Conservation and Natural Resources Alabama Department of Economic and Community Affairs Alabama Department of Environmental Management Alabama Development Office Alabama Historical Commission Alabama National Guard Alabama Coastal Management Program Alabama State Port Authority State Oil and Gas Board of Alabama	Baldwin County City of Mobile County of Mobile

Table 8.3-1: Entities that Received the Draft Environmental Impact Statement/Overseas Environmental Impact Notification Letter (continued)

Alabama		
Connecticut		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Connecticut Commission on Culture & Tourism, State Historic Preservation Office Connecticut Council on Environmental Quality Connecticut Department of Economic and Community Development Connecticut Department of Energy and Environmental Protection Connecticut Department of Public Health Connecticut Environmental and Occupational Health Assessment Program Connecticut National Guard Connecticut Office of Military Affairs Connecticut Siting Council	City of New London Town of Groton
Delaware		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Delaware Division of Historical and Cultural Affairs Delaware Economic Development Office Delaware Heritage Commission Delaware River Basin Commission Delaware River and Bay Authority Delaware National Guard Delaware Office of Management and Budget: Budget Development, Planning, and Administration Department of Natural Resources and Environmental Control Delaware State Historic Preservation Office	

Table 8.3-1: Entities that Received the Draft Environmental Impact Statement/Overseas Environmental Impact Notification Letter (continued)

Florida		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Florida Department of Environmental Protection Florida Fish and Wildlife Conservation Commission Florida Fish and Wildlife Conservation Commission Florida State Clearinghouse Florida Department of Economic Opportunity Florida Department of Military Affairs Florida Department of State Florida Department of Transportation Florida Division of Historical Resources St. Johns River Water Management District Workforce Florida	Bay County Brevard County Broward County Cape Canaveral Port Authority City of Atlantic Beach City of Cape Canaveral City of Dania Beach City of Jacksonville City of Key West City of Milton City of Pensacola County of Escambia Jacksonville Port Authority Jacksonville Aviation Authority Jacksonville Waterways Commission Monroe County Panama City Panama City Beach Panama City Port Authority Pensacola Regional Airport Port Canaveral Port of Panama City Port of Pensacola Santa Rosa County Southeast Citizens Planning Advisory Committee
Georgia		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Georgia Department of Defense Georgia Department of Economic Development Georgia Department of Natural Resources Georgia Environmental Finance Authority Georgia Forestry Commission Georgia Historic Preservation Division Georgia State Clearinghouse Jekyll Island Authority	City of Kingsland City of St. Mary's City of Woodbine County of Camden
Louisiana		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Louisiana Department of Culture, Recreation and Tourism Louisiana Economic Development Louisiana Department of Environmental Quality Louisiana Department of Natural Resources Louisiana State Military Department / Louisiana National Guard Port of New Orleans	City of New Orleans

Table 8.3-1: Entities that Received the Draft Environmental Impact Statement/Overseas Environmental Impact Notification Letter (continued)

Maine		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Historic Preservation Commission Maine Department of Agriculture, Conservation and Forestry Maine Department of Environmental Protection Maine Department of Inland Fisheries and Wildlife Maine Department of Marine Resources Maine Military Authority Maine State Planning Office Maine National Guard and Maine Department of Defense, Veterans, and Emergency Management	City of Bath City of Portland Cumberland County Town of Kittery
Maryland		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Chesapeake Bay Commission Maryland Department of Environment Maryland Department of Natural Resources Maryland Department of Agriculture Maryland Department of Business and Economic Development Maryland Department of Planning Maryland Department of Transportation Maryland Economic Development Corporation Maryland Environmental Service Maryland Historical Trust Maryland State Clearinghouse for Intergovernmental Assistance	Town of Ocean City Somerset County Wicomico County Worcester County

Table 8.3-1: Entities that Received the Draft Environmental Impact Statement/Overseas Environmental Impact Notification Letter (continued)

Massachusetts		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Berkshire Regional Planning Commission Cape Cod Commission Central Massachusetts Regional Planning Commission Franklin Regional Council of Governments Martha's Vineyard Commission Massachusetts Department of Conservation and Recreation Massachusetts Department of Environmental Protection Massachusetts Department of Public Health Massachusetts Executive Office of Health and Human Services Massachusetts Historical Commission Massachusetts National Guard Massachusetts Port Authority Massachusetts Regional Planning Commission Massachusetts Water Resources Authority Merrimack Valley Planning Commission Metropolitan Area Planning Council Montachusett Regional Planning Commission Nantucket Planning and Economic Development Commission Pioneer Valley Planning Commission Seaport Economic Council Southeastern Regional Planning and Economic Development District	City of Boston Town of Barnstable Northern Middlesex Council of Government
Mississippi		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Gulf of Mexico Program Office Mississippi Department of Archives and History, Historic Preservation Division, Federal and State Project Review Mississippi Department of Environmental Quality Mississippi Department of Marine Resources Mississippi Forestry Commission Mississippi National Guard Mississippi Soil and Water Conservation Commission Mississippi State Oil and Gas Board Mississippi State Port Authority	City of Meridian City of Moss Point City of Pascagoula Harrison County Jackson County Port of Pascagoula

Table 8.3-1: Entities that Received the Draft Environmental Impact Statement/Overseas Environmental Impact Notification Letter (continued)

New Hampshire		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	New Hampshire Department of Cultural Resources New Hampshire Department of Environmental Services New Hampshire Department of Resources and Economic Development New Hampshire Department of Safety New Hampshire Division of Forests and Lands New Hampshire Division of Historical Resources New Hampshire Fish and Game Department New Hampshire National Guard New Hampshire Office of Energy and Planning State of New Hampshire Economic Development	City of Portsmouth Rockingham County
New Jersey		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Delaware River Basin Commission Garden State Preservation Trust Jersey Pinelands Commission New Jersey Department of Agriculture New Jersey Department of Environmental Protection New Jersey Department of Environmental Protection: Office of Permit Coordination and Environmental Review New Jersey Department of Military and Veterans Affairs New Jersey Economic Development Authority New Jersey Historic Preservation Office New Jersey Historic Trust New Jersey Historical Commission Pinelands Municipal Council	Atlantic County Ocean County
New York		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	New York State Department of Environmental Conservation New York Department of State, Office of Communities and Waterfronts New York Division of Military and Naval Affairs New York Office of Parks, Recreation and Historic Preservation	Long Island, Nassau County Long Island, Suffolk County

Table 8.3-1: Entities that Received the Draft Environmental Impact Statement/Overseas Environmental Impact Notification Letter (continued)

North Carolina		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	NCEast Alliance North Carolina Advisory Commission on Military Affairs North Carolina Department of Administration North Carolina Department of Cultural Resources North Carolina Department of Environment and Natural Resources North Carolina Department of Public Safety North Carolina Department of Transportation North Carolina Division of Parks and Recreation North Carolina Economic Developers Association North Carolina National Guard North Carolina State Historic Preservation Office North Carolina State Ports Authority North Carolina Wildlife Resources Commission North Carolina's Southeast Economic Development Organization Office of Conservation, Planning and Community Affairs	City of Havelock City of Jacksonville City of Wilmington Coastal Carolina Regional Air Port Authority County of Carteret County of Craven County of Jones County of Pamlico County Of Pender Morehead City Onslow County Town of Nags Head Port of Morehead City Port of Wilmington
Rhode Island		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Rhode Island Coastal Resources Management Council Rhode Island Department of Administration Rhode Island Department of Environmental Management Rhode Island Department of Health Rhode Island Historical Preservation & Heritage Commission Rhode Island Division of Planning Rhode Island National Guard Rhode Island Water Resources Board	City of Newport

Table 8.3-1: Entities that Received the Draft Environmental Impact Statement/Overseas Environmental Impact Notification Letter (continued)

South Carolina		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	South Carolina Department of Natural Resources South Carolina Office of State Budget South Carolina Department of Agriculture South Carolina Department of Health and Environmental Control South Carolina Department of Parks, Recreation, and Tourism South Carolina Forestry Commission South Carolina Military Department South Carolina Sea Grant Consortium South Carolina State Historic Preservation Office South Carolina State Ports Authority	City of Charleston
Texas		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Brazos River Authority Houston Port Authority Lower Colorado River Authority Texas Bureau of Economic Geology Texas Commission on Environmental Quality Texas General Land Office Texas Historical Commission Texas Military Forces Texas Parks and Wildlife Department Texas Water Development Board	City of Corpus Christi County of Kleberg County of Nueces County of San Patricio Port of Corpus Christi
Virginia		
State Elected Officials	***State Agencies***	***Local***
Office of the Governor Congressional Delegates	Chesapeake Bay Commission Potomac River Fisheries Commission Virginia Aquarium/Stranding Center Virginia Department of Agriculture and Forestry Virginia Department of Conservation and Recreation Virginia Department of Environmental Quality Virginia Department of Game and Inland Fisheries Virginia Department of Historic Resources Virginia Department of Natural Resources Virginia Department of Planning and Budget Virginia Department of Transportation Virginia Marine Resources Commission Virginia Museum of Natural History Virginia National Guard Virginia Port Authority Virginia Resources Authority	City of Newport News City of Norfolk City of Portsmouth City of Virginia Beach County of Accomack Hampton Roads Military and Federal Facilities Alliance Hampton Roads Planning District Commission Norfolk Environmental Commission Town of Chincoteague Virginia Beach Convention & Visitors Bureau Western Tidewater Community Services Board

Table 8.3-1: Entities that Received the Draft Environmental Impact Statement/Overseas Environmental Impact Notification Letter (continued)

U.S. Virgin Islands		
Elected Officials	***Agencies***	***Local***
Office of the Governor Congressional Delegates	Department of Planning & Natural Resources Department of Planning & Natural Division of Environmental Protection Historic Preservation Office	
Regional		
Federal Agencies		
Advisory Council on Historic Preservation, Office of Federal Agency Programs		
Assateague National Seashore		
Bureau of Indian Affairs, Eastern Region		
Bureau of Indian Affairs, Southern Plains Region		
Bureau of Ocean Energy Management, Office of Renewable Energy Programs		
Canaveral National Seashore		
Cape Cod National Seashore		
Council on Environmental Quality		
Department of Commerce		
Department of Interior, Atlanta Regional Office		
Department of Interior, Boston Regional Office		
Department of Interior, Bureau of Ocean Energy Management		
Department of Interior, Bureau of Safety & Environmental Enforcement, Gulf of Mexico Region		
Dry Tortugas National Park		
Federal Aviation Administration		
Federal Aviation Administration, Eastern Region		
Federal Aviation Administration, New England Region		
Federal Aviation Administration, Southern Region		
Federal Aviation Administration, Southwest Region		
Fishery Management Council, Caribbean		
Fishery Management Council, Gulf of Mexico		
Fishery Management Council, Mid-Atlantic		
Fishery Management Council, New England		
Fishery Management Council, South Atlantic		
Gulf State Marine Fisheries Commission		
John F. Kennedy Space Center		
Marine Mammal Commission		
Mid-Atlantic Fishery Management Council		
National Aeronautics and Space Administration, Goddard Space Flight Center, Wallops Environmental Office		
National Marine Fisheries Service		
National Marine Fisheries Service, West Palm Beach Field Office		
National Marine Fisheries Science Center, Northeast Region Fisheries Science Center		
National Marine Fisheries Service, Southeast Fisheries Science Center		
National Marine Fisheries Service, Beaufort Laboratory		
National Marine Fisheries Service, Galveston Lab		
National Marine Fisheries Service, Habitat Conservation Division		
National Marine Fisheries Service, James J Howard Marine Science Lab		
National Marine Fisheries Service, Lafayette Lab		

Table 8.3-1: Entities that Received the Draft Environmental Impact Statement/Overseas Environmental Impact Notification Letter (continued)

National Marine Fisheries Service, Miami Lab
National Marine Fisheries Service, Milford Lab
National Marine Fisheries Service, Narragansett Lab
National Marine Fisheries Service, National Systematics Laboratory
National Marine Fisheries Service, Northeast Regional Office
National Marine Fisheries Service, Office of Habitat Conservation, Program Planning & Integration Office
National Marine Fisheries Service, Office of Ocean Exploration and Research
National Marine Fisheries Service, Office of Protected Resources
National Marine Fisheries Service, Panama City Lab
National Marine Fisheries Service, Pascagoula Lab
National Marine Fisheries Service, Southeast Regional Office
National Marine Fisheries Service, Stennis Lab
National Marine Fisheries Service, West Palm Beach Field Office
National Oceanic & Atmospheric Administration
National Oceanic and Atmospheric Administration, Beaufort Field Office
National Oceanic and Atmospheric Administration, Chesapeake Bay Office
National Oceanic and Atmospheric Administration, Fisheries SERO, Right Whale Recovery Program
National Oceanic and Atmospheric Administration, Monitor National Marine Sanctuary
National Oceanic and Atmospheric Administration, Sapelo Island National Estuarine Research Reserve
National Office of Marine Sanctuaries, Flower Garden Banks National Marine Sanctuary
National Park Service
National Park Service, Cape Hatteras National Seashore
National Park Service, Cape Lookout National Seashore
National Park Service, Cumberland Island National Seashore
National Park Service, Gulf Islands National Seashore
National Park Service, Intermountain Region
National Park Service, Northeast Region
National Park Service, Padre Island National Seashore
National Park Service, Southeast Region
National Park Service, Timucuan Ecological and Historic Preserve
New England Fishery Management Council
National Oceanic and Atmospheric Administration Office of Marine Sanctuaries Florida Keys National Marine Sanctuary
National Oceanic and Atmospheric Administration Office of Marine Sanctuaries Gray's Reef National Marine Sanctuary
National Oceanic and Atmospheric Administration Office of Marine Sanctuaries Monitor National Marine Sanctuary
National Oceanic and Atmospheric Administration Office of Marine Sanctuaries Stellwagen Bank National Marine Sanctuary
National Oceanic and Atmospheric Administration Office of Marine Sanctuaries Virginia Institute of Marine Science
South Atlantic Fishery Management Council
U.S. Army Corps of Engineers, Planning and Environmental Division
U.S. Army Corps of Engineers, Headquarters
U.S. Army Corps of Engineers, Baltimore District
U.S. Army Corps of Engineers, Galveston District
U.S. Army Corps of Engineers, Jacksonville District

Table 8.3-1: Entities that Received the Draft Environmental Impact Statement/Overseas Environmental Impact Notification Letter (continued)

U.S. Army Corps of Engineers, New Orleans District
U.S. Army Corps of Engineers, New York District
U.S. Army Corps of Engineers, Norfolk District
U.S. Army Corps of Engineers, North Atlantic Division
U.S. Army Corps of Engineers, Philadelphia District
U.S. Army Corps Of Engineers, Regulatory Division
U.S. Army Corps Of Engineers, Savannah District
U.S. Army Corps of Engineers, Washington Regulatory Field Office
U.S. Army Corps of Engineers, Wilmington District
U.S. Coast Guard
U.S. Coast Guard Headquarters, Office of Environmental Management
U.S. Coast Guard, Atlantic Area
U.S. Coast Guard, District 1
U.S. Coast Guard, District 5
U.S. Coast Guard, District 7
U.S. Coast Guard, District 8
U.S. Coast Guard, District 9
U.S. Coast Guard, District Headquarters of Sector Jacksonville
U.S. Coast Guard, Sector North Carolina
U.S. Department of Agriculture
U.S. Department of Agriculture, Forest Service
U.S. Department of Agriculture, Forest Service, Eastern Region
U.S. Department of Agriculture, Forest Service, Ocala National Forest
U.S. Department of Agriculture, Forest Service, Southern Region
U.S. Department of Interior, Natural Resources Management Team
U.S. Department of Transportation, Maritime Administration, Office of Deepwater Ports and Offshore Activities
U.S. Department of Transportation, Maritime Administration, South Atlantic Region
U.S. Environmental Protection Agency
U.S. Environmental Protection Agency, Office of Enforcement and Compliance Assurance, Office of Federal Activities
U.S. Environmental Protection Agency, Office of Federal Activities, EIS Filing Section
U.S. Environmental Protection Agency, Region 1
U.S. Environmental Protection Agency, Region 2
U.S. Environmental Protection Agency, Region 3
U.S. Environmental Protection Agency, Region 4
U.S. Environmental Protection Agency, Region 6
U.S. Fish and Wildlife Service, Alligator River and Pea Island National Wildlife Refuges
U.S. Fish and Wildlife Service, Back Bay National Wildlife Refuge
U.S. Fish and Wildlife Service, Bears Bluff National Fish Hatchery
U.S. Fish and Wildlife Service, Cape Romain National Wildlife Refuge
U.S. Fish and Wildlife Service, Charleston Ecological Services Field Office
U.S. Fish and Wildlife Service, Chesapeake Bay Office
U.S. Fish and Wildlife Service, Chincoteague National Wildlife Refuge
U.S. Fish and Wildlife Service, Coastal Georgia Sub-Office (Townsend)
U.S. Fish and Wildlife Service, Ernest F. Hollings ACE Basin National Wildlife Refuge
U.S. Fish and Wildlife Service, Harris Neck National Wildlife Refuge
U.S. Fish and Wildlife Service, Headquarters
U.S. Fish and Wildlife Service, Mackay Island and Currituck National Wildlife Refuges
U.S. Fish and Wildlife Service, Mattamuskeet, Cedar Island and Swan Quarter

Table 8.3-1: Entities that Received the Draft Environmental Impact Statement/Overseas Environmental Impact Notification Letter (continued)

U.S. Fish and Wildlife Service, Merritt Island National Wildlife Refuge
U.S. Fish and Wildlife Service, North Florida Ecological Services Office
U.S. Fish and Wildlife Service, Raleigh Field Office
U.S. Fish and Wildlife Service, Region 2
U.S. Fish and Wildlife Service, Region 4
U.S. Fish and Wildlife Service, Region 5
U.S. Fish and Wildlife Service, Savannah Coastal Refuges
U.S. Fish and Wildlife Service, Virginia Field Office
U.S. Fish and Wildlife Service, Waccamaw National Wildlife Refuge
U.S. Geological Survey
U.S. Geological Survey, Water Resources
U.S. Fish and Wildlife Service, Edenton National Fish Hatcheryv

DEPARTMENT OF THE NAVY
U.S. FLEET FORCES COMMAND
1562 MITSCHER AVENUE SUITE 250
NORFOLK, VA 23551-2487

5090
Ser N46/072
June 30, 2017

Colonel Jason Kelly
District Engineer U.S. Army Corps of Engineers, Norfolk District
803 Front St.
Norfolk, VA 23510

Dear Colonel Kelly:

The Department of the Navy has prepared a Draft Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) to analyze the potential effects from training and testing activities conducted within the Navy's Atlantic Fleet Training and Testing (AFTT) Study Area. The U.S. Navy is requesting and welcomes your comments on the Draft EIS/OEIS.

The Study Area is in the western Atlantic Ocean and encompasses the waters along the east coast of North America and the Gulf of Mexico, portions of the Caribbean Sea, Navy pierside locations and port transit channels, waters near civilian ports, and inland waters (e.g., lower Chesapeake Bay). The AFTT Study Area covers approximately 2.6 million square nautical miles of ocean space and includes designated U.S. Navy operating areas and special use airspace (see enclosure).

The U.S. Navy's mission is to maintain, train and equip combat-ready naval forces capable of winning wars, deterring aggression, and maintaining freedom of the seas as mandated by federal law (Title 10 U.S. Code § 5062). The Chief of Naval Operations is charged with ensuring the readiness of the nation's naval forces and meets that directive, in part, by establishing and executing training programs and ensuring naval forces have access to training ranges, operating areas, and airspace needed to develop and maintain skills for the conduct of operations.

The Navy's Proposed Action is to conduct training and testing activities, which may include the use of active sonar and explosives. For more information on the U.S. Navy's Proposed Action and alternatives currently under consideration, please see the enclosure.

In compliance with the National Environmental Policy Act of 1969, the U.S. Navy is holding five public meetings to inform and provide an opportunity for the public to comment on the Proposed Action, alternatives under consideration, and the adequacy and accuracy of the analysis in the Draft EIS/OEIS. All comments (oral or written) submitted during the 60-day public review period (June 30, 2017, to August 29, 2017) will become part of the public record on the Draft EIS/OEIS and substantive comments will be addressed in the Final EIS/OEIS.

U.S. Navy representatives will be available during the public meetings to provide information and answer questions. Members of the public can arrive anytime between 4 p.m. and 8 p.m. The public meeting schedule is as follows:

1

Figure 8.3-1: Stakeholder Letter for the Notification of the Draft Environmental Impact Statement/Overseas Environmental Impact Statement

5090
Ser N46/072
June 30, 2017

Wednesday, July 19, 2017
Hotel Providence
139 Mathewson Street
Providence, RI 02903

Tuesday, July 25, 2017
UNC Institute of Marine Sciences
3431 Arendell Street
Morehead City, NC 28557

Wednesday, July 26, 2017
Nauticus
One Waterside Drive
Norfolk, VA 23510

Tuesday, August 1, 2017
The Prime F. Osborn III
Convention Center
1000 Water Street
Jacksonville, FL 32204

Thursday, August 3, 2017
Gulf Coast State College
Conference Center
5230 W. Highway 98
Panama City, FL 32401

The Draft EIS/OEIS and additional information are available on the project website at: **www.AFTTEIS.com**.

Written comments may be submitted during public meetings or mailed to the following address:

Naval Facilities Engineering Command Atlantic
Attn: Code EV22KP
6506 Hampton Blvd
Norfolk, VA 23508-1278

Online comments may also be submitted on the project website. All comments must be postmarked or received online by August 29, 2017, for consideration in the Final EIS/OEIS.

Sincerely,

Elizabeth A Nashold

Elizabeth Nashold
Director, Fleet Installations and Environment
and Deputy Director

Enclosure: U.S. Navy AFTT EIS/OEIS Project Description and Study Area Map

2

Figure 8.3-1: Stakeholder Letter for the Notification of the Draft Environmental Impact Statement/Overseas Environmental Impact Statement (continued)

U.S. NAVY ATLANTIC FLEET TRAINING AND TESTING (AFTT) ENVIRONMENTAL IMPACT STATEMENT/OVERSEAS ENVIRONMENTAL IMPACT STATEMENT (EIS/OEIS) PROJECT DESCRIPTION AND STUDY AREA MAP

AFTT EIS/OEIS Proposed Action and Alternatives:

The Navy's Proposed Action is to conduct training and testing activities, which may include the use of active sonar and explosives, primarily within existing range complexes, operating areas, and testing ranges within the Atlantic Ocean along the eastern coast of North America, portions of the Caribbean Sea, in the Gulf of Mexico at Navy pierside locations and port transit channels, near civilian ports, and in inland waters (e.g., the lower Chesapeake Bay). These military readiness activities are generally consistent with those analyzed in the AFTT EIS/OEIS completed in December 2013 and are representative of training and testing that the Navy has been conducting in the AFTT Study Area for decades.

The purpose of the Proposed Action is to ensure that the Navy meets its mission under Title 10 United States Code Section 5062, which is to maintain, train and equip combat-ready naval forces capable of winning wars, deterring aggression, and maintaining freedom of the seas.

No Action Alternative – Under the No Action Alternative, the Proposed Action would not take place (i.e., the Navy would not conduct proposed training and testing activities in the AFTT Study Area). For National Marine Fisheries Service (NMFS), denial of an application for an incidental take authorization constitutes the NMFS No Action Alternative, which is consistent with NMFS' statutory obligation under the Marine Mammal Protection Act (MMPA) to grant or deny requests for take incidental to specified activities. The resulting environmental effects from taking no action will be compared with the effects of the Proposed Action.

Alternative 1 - Under this alternative, the Navy proposes to conduct military readiness training and testing activities into the reasonably foreseeable future, as necessary to meet current and future readiness requirements. These military readiness training activities include new activities as well as activities subject to previous analysis that are currently ongoing and have historically occurred in the Study Area. These activities account for force structure (organization of ships, weapons, and personnel) changes and include training and testing with new aircraft, vessels, unmanned/autonomous systems, and weapon systems that will be introduced to the fleets after November 2018.

Alternative 1 reflects a representative year of training to account for the natural fluctuations of training cycles and deployment schedules. Using representative years rather than a maximum tempo of training activity in every year has reduced the amount of hull-mounted mid-frequency active sonar estimated to be necessary to meet training requirements. In addition, this alternative would not include the contingency for augmenting some weapon systems tests, accepts a lower level of overall military commitment resulting from a stable level of

Enclosure (1)

Figure 8.3-1: Stakeholder Letter for the Notification of the Draft Environmental Impact Statement/Overseas Environmental Impact Statement (continued)

world conflict, and accepts that military readiness requirements would not require increased levels of annual testing of anti-submarine warfare and mine warfare systems.

Alternative 2 – As under Alternative 1, Alternative 2 includes new and ongoing activities. Under this alternative, the Navy would be enabled to meet the highest levels of required military readiness in order to respond to a direct challenge from a naval opponent. Alternative 2 reflects the maximum number of training and testing activities that could occur within a given year, and assumes that the maximum level of activity would occur every year over any 5-year period. This allows for the greatest flexibility for the Navy to maintain readiness when considering potential changes in the national security environment, fluctuations in training and deployment schedules, and anticipated in-theater demands. Both unit-level training and major training exercises are assumed to occur at a maximum level every year.

This alternative also includes the contingency for augmenting some weapon systems tests in response to potential increased world conflicts and changing Navy leadership priorities required to meet the highest levels of military readiness in order to respond to a direct challenge from a naval opponent that possesses near-peer capabilities. Therefore, this alternative would include the provision for higher levels of annual testing of certain anti-submarine warfare and mine warfare systems to support expedited delivery of these systems to the fleet.

Environmental Analysis:

Environmental effects which might result from the implementation of the Navy's Proposed Action or alternatives have been analyzed in this EIS/OEIS. Resource areas analyzed include air quality, sediments and water quality, vegetation, invertebrates, habitats, fishes, marine mammals, reptiles, birds and bats, cultural resources, socioeconomic resources, and public health and safety.

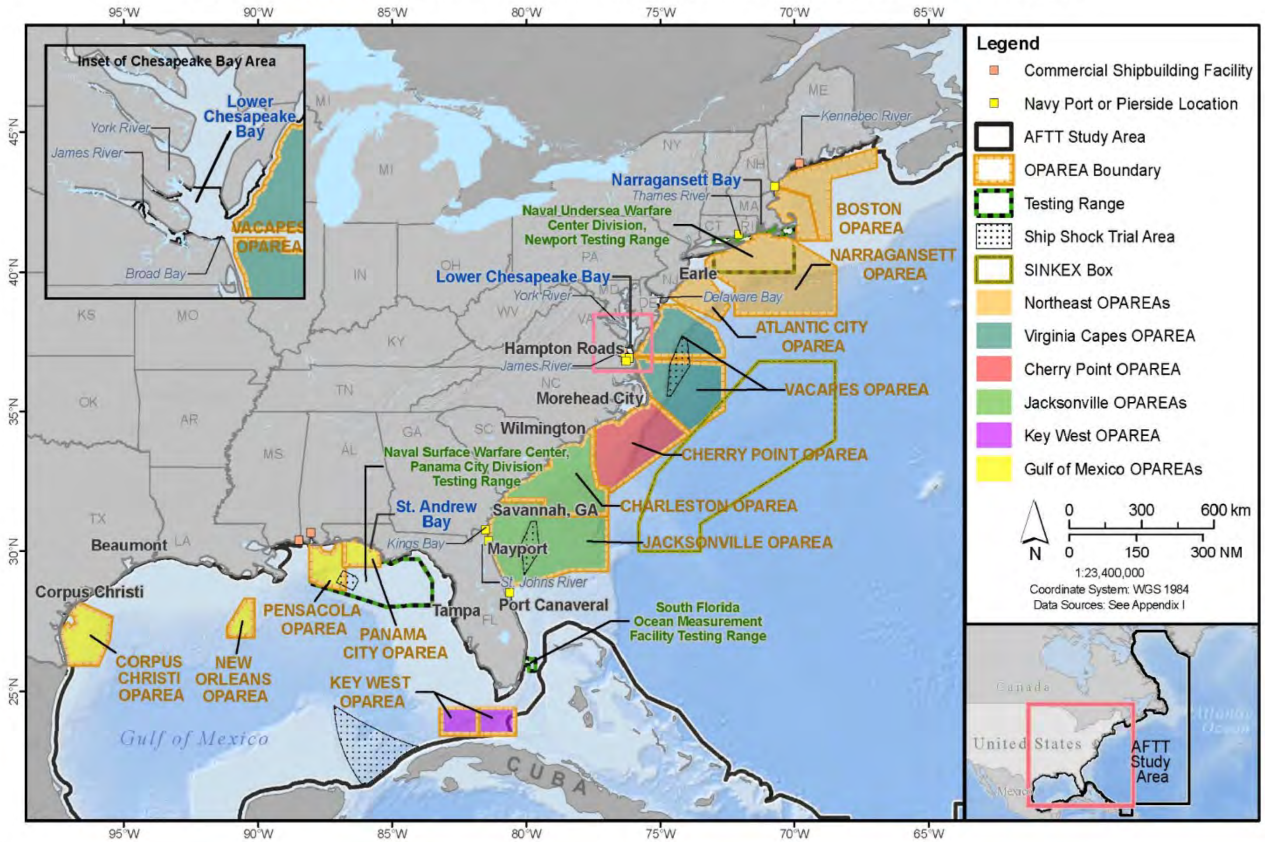
AFTT Study Area:

The Study Area covers approximately 2.6 million square nautical miles of ocean area, and includes designated Navy range complexes and testing ranges shown on the map included here. The Study Area includes only the in-water components of the range complexes and testing ranges; land components associated with the range complexes and testing ranges are not included in the Study Area and no activities on these land areas are included as part of the Proposed Action. The Study Area also includes various bays, harbors, inland waterways, and pierside locations which are within the boundaries of the range complexes.

Enclosure (1)

Figure 8.3-1: Stakeholder Letter for the Notification of the Draft Environmental Impact Statement/Overseas Environmental Impact Statement (continued)

Figure 1: U.S. Navy Atlantic Fleet Training and Testing EIS/OEIS Study Area



Enclosure (1)

Figure 8.3-1: Stakeholder Letter for the Notification of the Draft Environmental Impact Statement/Overseas Environmental Impact Statement (continued)

8.3.1.2 Subscribers Email

Project information was also distributed via the project web site subscribers email distribution list. A copy of the email sent to announce the availability of the Public Release Draft EIS/OEIS and provided information on ways to comment and public meeting times and locations in included as Figure 8.3-2.

8.3.1.3 Public Involvement Website

A public involvement website, www.AFTTEIS.com, housed a series of fact sheets and videos that explained specifics of the Proposed Action and described the overall planning process. Topics included:

- National Environmental Policy Act Process and Timeline
- Importance of Navy Training and Testing
- Study Area Map Proposed Action and Alternatives
- Training and Testing Active Sonar and Explosives
- Navy Acoustic Effects Model
- Marine Resource Protection
- Public Access and Safety
- Participating Navy Commands

The website provided additional in-depth informational videos that covered the following topics:

- The Importance of Navy Training and Testing
- Proposed Action and Alternatives
- Training and Testing Active Sonar and Explosives
- Introduction to Navy Acoustic Effects Model
- Marine Resource Protection
- Public Access and Safety

You previously requested to receive information regarding the Department of the Navy's Atlantic Fleet Training and Testing (AFTT) Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS). This email provides an update on the draft document and ways to participate in the planning process.

The Department of the Navy's notice announcing the availability of the Draft EIS/OEIS was published in the Federal Register on June 30, 2017. The U.S. Navy is requesting and welcomes your comments on the Draft EIS/OEIS during the 60-day public review period (July 1 to August 29, 2017). All comments will become part of the public record and substantive comments will be addressed in the Final EIS/OEIS.

You can participate in the Navy's planning process through attendance at one of the five public meetings and by submitting comments (written or oral) on the Navy's Draft EIS/OEIS during these meetings, on the AFTT website, or via mail. All comments must be received online or postmarked by August 29, 2017, for consideration in the Final EIS/OEIS.

U.S. Navy representatives will be available during the public meetings to provide information and answer questions. The public meetings will be held in the following cities:

- Providence, RI
- Morehead City, NC
- Norfolk, VA
- Jacksonville, FL
- Panama City, FL

Information on the Draft EIS/OEIS, the public meeting locations and times, and ways to provide comments is provided on the project website at www.AFTTEIS.com.

The U.S. Navy appreciates your interest and participation in the environmental planning process.

Figure 8.3-2: Project Website Subscribers Email for the Notification of the Draft Environmental Impact Statement/Overseas Environmental Impact Statement

8.3.1.4 Postcard Mailers

More than 500 postcards were sent to individuals, agencies, and organizations. The postcards acted as formal notification of the Notice of Availability of the AFTT Draft EIS/OEIS and announcement of public meetings. An example of the Notice of Availability postcard is shown in Figure 8.3-3 and Figure 8.3-4.

8.3.1.5 Press Releases

Press releases to announce the public meetings for the Draft EIS/OEIS were released on 29 June 2017, 14 July 2017, 21 July 2017, 24 July 2107, 27 July 2017, and 31 July 2017. These press releases provided a description of the Proposed Action, address of the project website, duration of the comment period, address of locations that the AFTT Draft EIS/OEIS could be viewed, and information on the public meetings. An example of one of these press releases can be found in Figure 8.3-5.

8.3.1.6 Newspaper Advertisements

To announce the Notification of Availability of the AFTT Draft EIS/OEIS and public meetings, advertisements were placed in the listed newspapers on the dates indicated in Table 8.3-2. The advertisements included a description of the Proposed Action, the project website, the duration of the comment period, and information on how to provide comments. An example of the advertisement is shown in Figure 8.3-6.

ATLANTIC FLEET
TRAINING AND TESTING EIS/OEIS
for Activities in 2018 and Beyond

The U.S. Navy invites you to participate in the National Environmental Policy Act (NEPA) process for the Atlantic Fleet Training and Testing Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS).

The Navy has prepared a Draft EIS/OEIS to analyze the potential effects from training and testing activities conducted within the Navy's Atlantic Fleet Training and Testing Study Area. Public input is requested on the Navy's activities and on the accuracy and adequacy of the Draft EIS/OEIS analysis.

Open House Public Meetings
4 p.m. to 8 p.m.

Providence, RI:
July 19, 2017
Hotel Providence
139 Mathewson Street
Providence, RI 02903

Morehead City, NC:
July 25, 2017
UNC Institute of
Marine Sciences
3431 Arendell Street
Morehead City, NC 28557

Norfolk, VA:
July 26, 2017
Nauticus
One Waterside Drive
Norfolk, VA 23510

Jacksonville, FL:
August 1, 2017
The Prime F. Osborn III
Convention Center
1000 Water Street
Jacksonville, FL 32204

Panama City, FL:
August 3, 2017
Gulf Coast State College
Conference Center
5230 W. Highway 98
Panama City, FL 32401

The Navy Requests Your Input!

You can participate in several ways:

- Visit **www.AFTTEIS.com** to learn more about the project, view the Draft EIS/OEIS, and submit comments
- Attend an open house public meeting to speak with project representatives and submit written and oral comments
- Mail written comments to:
  Naval Facilities Engineering
  Command Atlantic
  Attention: Code: EV22KP
  6506 Hampton Blvd.
  Norfolk, VA 23508-1278

Comments must be postmarked or received online by **August 29, 2017** for consideration in the Final EIS/OEIS.

Figure 8.3-3: Postcard for the Notification of Availability of the Draft Environmental Impact Statement/ Overseas Environmental Impact Statement and Announcement of Public Meetings (front)

Proposed Action

The Navy proposes to conduct training and testing activities - which may include the use of active sonar and explosives - primarily within existing range complexes and testing ranges along the east coast of the United States, in portions of the Caribbean Sea, the Gulf of Mexico, at Navy pierside locations, port transit channels, near civilian ports, and in inland waters (e.g., the lower Chesapeake Bay). Proposed activities are similar to the types of activities that have been occurring for decades in the Study Area.

The Proposed Action is needed to accomplish the Navy mission to maintain, train, and equip combat-ready naval forces capable of winning wars, deterring aggression, and maintaining freedom of the seas.

Naval Facilities Engineering
Command Atlantic
Attention: Code: EV22KP
6506 Hampton Blvd.
Norfolk, VA 23508-1278

Figure 8.3-4: Postcard for the Notification of Availability of the Draft Environmental Impact Statement/ Overseas Environmental Impact Statement and Announcement of Public Meetings (back)

PRESS RELEASE

Public Affairs Office
Commander, U.S. Fleet Forces Command
1562 Mitscher Avenue, Suite 250
Norfolk, Va. 23551-2487
(757) 836-4427
Fax: (757) 836-3601

FOR IMMEDIATE RELEASE

Press Release 11-17
July 14, 2017

Navy to Host Atlantic Fleet Training and Testing Draft Environmental Impact Statement Public Meeting in Providence

The Navy has prepared and filed with the U.S. Environmental Protection Agency a Draft Environmental Impact Statement (EIS)/Overseas EIS (OEIS) to evaluate the potential environmental effects from training and testing activities conducted within the Navy's Atlantic Fleet Training and Testing (AFTT) Study Area.

With the filing of the Draft EIS/OEIS, the Navy initiated a 60-day public comment period and has scheduled five public meetings to receive comments on the Draft EIS/OEIS. The first public meeting will be held Wednesday, July 19, 2017, at Hotel Providence, 139 Mathewson Street, Providence, RI.

The Draft EIS analyzes training and testing activities planned to occur across all operating areas off the East Coast and the Gulf of Mexico starting in November of 2018, and analyzes the potential impacts on the physical, biological, and socioeconomic environments within the Study Area, along with extensive mitigation measures used to reduce impacts. The activities described in this EIS are consistent with the activities analyzed in the previous Atlantic Fleet Training and Testing EIS completed in August of 2013 and have been on-going in the study area for decades.

This is the third time the Navy has conducted comprehensive planning and permitting for Navy training and testing (Phase I covered 2008–2013, Phase II covers 2013-2018). The Phase III AFTT EIS will support re-authorizations of Marine Mammal Protection Act (MMPA) permits by the National Marine Fisheries Service (NMFS) for Navy training and testing activities, with the new permits taking effect in November of 2018. The Navy does not plan to change the type or tempo of these activities from previous levels analyzed in the 2013 AFTT EIS.

The public meeting will be conducted in an open-house format with informational stations staffed by Navy representatives. These representatives will be available during the meeting to clarify information related to the Draft EIS/OEIS. Federal, state, and local agencies and officials, and interested groups and individuals are encouraged to provide comments in person at any of the public meetings or in writing during the public comment period.

Attendees will be able to submit comments in writing or orally using a voice recorder. Equal weight will be given to oral and written statements. Comments may also be submitted by U.S. postal mail or electronically via the project website (www.AFTTEIS.com).

Figure 8.3-5: Press Release of Notification of Availability of the Draft Environmental Impact Statement/ Overseas Environmental Impact Statement and Announcement of Public Meetings

AFTT DEIS PROVIDENCE MEETING -2-2-2-2

Written comments may be submitted by mail to Naval Facilities Engineering Command Atlantic, Attn: Code EV22KP (AFTT EIS Project Managers), 6506 Hampton Boulevard, Norfolk, VA 23508-1278 and through the project website; all written comments must be postmarked or received by August 29, 2017. All statements, oral or written, submitted during the public review period will become part of the public record on the Draft EIS/OEIS and will be considered in preparation of the Final EIS/OEIS.

Copies of the Draft EIS/OEIS are available for public review at the following area libraries:
- Boston Public Library, Central Library, 700 Boylston Street, Boston, MA 02116
- Portland Public Library, 5 Monument Square, Portland, ME 04101
- Providence Public Library, 150 Empire Street, Providence, RI 02903
- Public Library of New London, 63 Huntington Street, New London, CT 06320

Copies of the AFTT Draft EIS/OEIS are also available for electronic viewing at www.AFTTEIS.com. A paper copy of the Executive Summary and a single compact disc (CD) of the Draft EIS/OEIS will be made available upon written request by contacting: Naval Facilities Engineering Command Atlantic, Attn: Code EV22KP (AFTT EIS Project Managers), 6506 Hampton Boulevard, Norfolk, VA 23508-1278.

-USN-

Figure 8.3-5: Press Release of Notification of Availability of the Draft Environmental Impact Statement/ Overseas Environmental Impact Statement and Announcement of Public Meetings (continued)

Table 8.3-2: Newspaper Announcements of Notification of Availability of the Draft Environmental Impact Statement/Overseas Environmental Impact Statement and Announcement of Public Meetings

Portland, ME *The Portland Press Herald* July 2, 2017	**Cumberland and Sagadahoc Counties, ME** *The Times Record* June 30, 2017	**New Bedford, MA** *The Standard Times* July 2, 2017
Boston, MA *The Boston Herald* July 2, 2017	**Providence, RI** *The Providence Journal* July 2, 2017	**Newport, RI** *The Newport Daily News* July 1, 2017
Salisbury, MD *The Daily Times* July 2, 2017	**Norfolk, VA** *The Virginia Pilot* July 2, 2017	**Newport News, VA** *The Daily Press* July 2, 2017
Nags Head, NC *Outer Banks Sentinel* July 5, 2017	**Jacksonville, NC** *Jacksonville Daily News* July 2, 2017	**Wilmington, NC** *Wilmington Star News* July 2, 2017
Charleston, SC *Charleston Post and Courier* July 2, 2017	**Savannah, GA** *Savannah Morning News* **July 2, 2017**	**Jacksonville, FL** *Florida Times Union* July 2, 2017
Fort Lauderdale, FL *Florida Sun Sentinel* July 2, 2017	**Brevard, FL** *Florida Today* July 2, 2017	**Panama City, Bay County, FL** *The News Herald* July 2, 2017
Pensacola, FL *Pensacola News Journal* July 2, 2017	**New Orleans, LA** *Times-Picayune* July 2, 2017	**Galveston, TX** *Galveston Daily News* July 2, 2017
Corpus Christi, TX *Caller-Times* July 2, 2017	**Pascagoula, MS** *The Mississippi Press* July 2, 2017	

The U.S. Navy
INVITES YOU TO PARTICIPATE
In the Atlantic Fleet Training and Testing
Environmental Impact Statement

The U.S. Navy has prepared a Draft Environmental Impact Statement/ Overseas Environmental Impact Statement (EIS/OEIS) to analyze the potential effects from training and testing activities conducted within the Navy's Atlantic Fleet Training and Testing (AFTT) Study Area. Public input is requested on the Navy's activities and on the accuracy and adequacy of the Draft EIS/OEIS analysis.

The Navy requests your input!

You can participate in the Draft EIS/OEIS process in a variety of ways:

- Visit www.AFTTEIS.com to learn more about the project, download and review a copy of the Draft EIS/OEIS, and submit comments.
- Mail written comments to the address listed below.
- Attend any of five open house public meetings to speak with project representatives and submit written and oral comments.
- Visit the Slover Memorial Main Library, 235 East Plume Street, Norfolk, VA 23510 to view the Draft EIS/OEIS.

PROPOSED ACTION

The Navy proposes to conduct training and testing in the AFTT Study Area. The purpose of the Proposed Action is to ensure that the Navy maintains, trains and equips a combat-ready force capable of winning wars, deterring aggression, and maintaining freedom of the seas.

SUBMIT WRITTEN COMMENTS TO

Naval Facilities Engineering Command Atlantic
Attention: Code EV22KP
6506 Hampton Blvd.
Norfolk, VA 23508-1278

SUBMIT COMMENTS ONLINE AT WWW.AFTTEIS.com

All comments must be postmarked or received online by August 29, 2017 for consideration in the Final EIS/OEIS.

Open House Public Meetings 4 to 8 p.m.

Providence, RI:
July 19, 2017
Hotel Providence
139 Mathewson Street
Providence, RI 02903

Morehead City, NC:
July 25, 2017
UNC Institute of Marine Sciences
3431 Arendell Street
Morehead City, NC 28557

Norfolk, VA:
July 26, 2017
Nauticus
One Waterside Drive
Norfolk, VA 23510

Jacksonville, FL:
August 1, 2017
The Prime F. Osborn III Convention Center
1000 Water Street
Jacksonville, FL 32204

Panama City, FL:
August 3, 2017
Gulf Coast State College Conference Center
5230 W. Highway 98
Panama City, FL 32401

For project details or information about accessing a copy of the Draft EIS/OEIS, visit www.AFTTEIS.com.

Figure 8.3-6: Newspaper Announcement of Notification of Availability of the Draft Environmental Impact Statement/Overseas Environmental Impact Statement and Announcement of Public Meetings

8.3.2 Public Meetings

Five public meetings were held on the following dates in the listed cities:

- 19 July 2017 in Providence, Rhode Island
- 25 July 2017 in Morehead City, North Carolina
- 26 July 2017 in Norfolk, Virginia
- 1 August 2017 in Jacksonville, Florida
- 3 August 2017 in Panama City, Florida

The meetings were structured in an open-house format, presenting informational posters and written information, with Navy staff and project experts available to answer participants' questions.

8.4 Distribution of the Draft and Final Environmental Impact Statement/Overseas Environmental Impact Statement

The agencies, individuals, and organizations listed in the sections below could access the document electronically via the website, received an electronic/hard copy of the EIS/OEIS, or could access hard copies as available at the information repositories discussed in Section 8.4.3 (Repositories). Since release of the Draft EIS/OEIS, points of contact at some of the agencies and organizations changed; therefore, the distribution lists were updated to reflect those changes. Although the points of contact may have changed, the same agencies and organizations received a copy of both the Draft and Final EIS/OEIS. For states not having a clearinghouse, a copy of the EIS/OEIS was sent to the most relevant state agency.

8.4.1 Federal Agencies

Electronic copies of the Draft and Final AFTT EIS/OEIS were delivered to the federal agencies listed in Table 8.4-1.

Table 8.4-1: Federal Agencies that Received the Draft and Final Environmental Impact Statement/ Overseas Environmental Impact Statement

Federal Agency
National Marine Fisheries Services (NMFS)
Ms. Cathryn Tortorici Chief, Endangered Species Act Interagency Cooperation Division Office of Protected Resources National Marine Fisheries Service National Oceanic and Atmospheric Administration 1315 East-West Highway, SSMC3, Room 13821 Silver Springs, MD 20910-3282
U.S. Environmental Protection Agency (EPA)
Mr. Tim Timmermann Office of Environmental Review U.S. EPA Region 1 5 Post Office Square , Suite 100 Boston, MA 02109-3912
Mr. Chris Militscher NEPA Program Office U.S. EPA Region 4 61 Forsyth Street, SW Atlanta, Ga 30303

Table 8.4-1: Federal Agencies that Received the Draft and Final Environmental Impact Statement/ Overseas Environmental Impact Statement (continued)

Federal Agency
Mr. John Pomponio Office of Environmental Programs Code 3EA30 U.S. EPA Region 3 1650 Arch Street Philadelphia, PA 19106
Mr. Samuel Coleman U.S. EPA Region 6 1445 Ross Avenue, Suite 1200 Dallas, TX 75202-2733
Ms. Catherine McCabe Environmental Review Section U.S. EPA Region 2 290 Broadway New York, NY 10007-1866

8.4.2 State Elected Officials

Electronic copies of the Draft and Final AFTT EIS/OEIS were delivered to the state governors listed in Table 8.4-2.

Table 8.4-2: State Governors that Received the Draft and Final Environmental Impact Statement/Overseas Environmental Impact Statement

State Governors		
Maine	***New Hampshire***	***Massachusetts***
The Honorable Paul LePage Governor, State of Maine Office of the Governor 1 State House Sta. Augusta, ME 04333	The Honorable Chris Sununu Governor, State of New Hampshire Office of the Governor 107 North Main St. Concord,NH 03301	The Honorable Charlie Baker Governor, Commonwealth of Massachusetts Office of the Governor State House, Rm. 280 Boston, MA 02133
Rhode Island	***Connecticut***	***New York***
The Honorable Gina M. Raimondo Governor, State of Rhode Island Office of the Governor 82 Smith St. Providence, RI 02903	The Honorable Dannel P. Malloy Governor, State of Connecticut Office of the Governor 210 Capitol Ave. Hartford, CT 06106	The Honorable Andrew M. Cuomo Governor State of New York Office of the Governor NYS State Capitol Bldg. Albany, NY 12224
New Jersey	***Delaware***	***Maryland***
The Honorable Phil Murphy Governor, State of New Jersey Office of the Governor P.O. Box 001 Trenton, NJ 08625	The Honorable John Carney Governor, State of Delaware Office of the Governor 150 Martin Luther King Jr. Blvd. Dover, DE 19901	The Honorable Larry Hogan Governor, State of Maryland Office of the Governor 100 State Cir. Annapolis, MD 21401

Table 8.4-2: State Governors that Received the Draft and Final Environmental Impact Statement/Overseas Environmental Impact Statement (continued)

Virginia	*North Carolina*	*South Carolina*
The Honorable Terry McAuliffe Governor, Commonwealth of Virginia Office of the Governor P.O. Box 1475 Richmond, VA 23218	The Honorable Roy Cooper Governor, State of North Carolina Office of the Governor 20301 Mail Service Center Raleigh, NC 27699-0301	The Honorable Henry McMaster Governor, State of South Carolina Office of the Governor 1205 Pendleton St. Columbia, SC 29201
Georgia	***Florida***	***Alabama***
The Honorable Nathan Deal Governor, State of Georgia Office of the Governor 206 Washington St., 111 State Capitol Atlanta, GA 30334	The Honorable Richard Scott Governor, State of Florida Office of the Governor 400 S. Monroe St. Tallahassee, FL 32399	The Honorable Kay Ivey Governor, State of Alabama Office of the Governor State Capitol, 600 Dexter Ave. Montgomery, AL 36130
Mississippi	***Louisiana***	***Texas***
The Honorable Phil Bryant Governor, State of Mississippi Office of the Governor P.O. Box 139 Jackson, MS 39205	The Honorable John Bel Edwards Governor, State of Louisiana Office of the Governor P.O. Box 94004 Baton Rouge, LA 70804	The Honorable Greg Abbott Governor, State of Texas Office of the Governor P.O. Box 12428 Austin, TX 78711-2428

8.4.3 Repositories

Electronic copies of the Draft and Final AFTT EIS/OEIS were also delivered to the repositories listed in Table 8.4-3.

Table 8.4-3: Repositories that Received the Draft and Final Environmental Impact Statement/ Overseas Environmental Impact Statement

AFTT Information Repositories
Maine
Portland Public Library 5 Monument Sq. Portland, ME 04101
Massachusetts
Boston Public Library, Central Library 700 Boylston St. Boston, MA 02116
Hyannis Public Library 401 Main St. Hyannis, MA 02601
Rhode Island
Providence Public Library 150 Empire St. Providence, RI 02903

Table 8.4-3: Repositories that Received the Draft and Final Environmental Impact Statement/ Overseas Environmental Impact Statement (continued)

Connecticut
Public Library of New London 63 Huntington St. New London, CT 06320
Maryland
Anne Arundel County Public Library 5 Harry S. Truman Parkway Annapolis, MD 21401
Virginia
Slover Memorial Main Library 235 E. Plume St. Norfolk, VA 23510
North Carolina
Kill Devil Hills Branch Library 400 Mustian St. Kill Devil Hills, NC 27948
Dare County Library, Manteo 700 Highway 64/264 Manteo, NC 27954
Havelock-Craven County Public Library 301 Cunningham Blvd. Havelock, NC 28532
Onslow County Library 58 Doris Avenue East Jacksonville, NC 28540
Carteret County Public Library 1702 Live Oak St., Suite 100 Beaufort, NC 28516
AFTT Information Repositories
Webb Memorial Library Center 8112 Evans St. Morehead City, NC 28557
New Hanover County Public Library 201 Chestnut Street Wilmington, NC 28401
South Carolina
Charleston County Public Library 68 Calhoun St. Charleston, SC 29401
Georgia
Camden County Public Library 1410 Highway 40 E. Kingsland, GA 31548

Table 8.4-3: Repositories that Received the Draft and Final Environmental Impact Statement/ Overseas Environmental Impact Statement (continued)

Florida
Jacksonville Public Library 303 N. Laura St. Jacksonville, FL 32202
West Palm Beach Library 411 Clematis St. West Palm Beach, FL 33401
Monroe County Public Library 700 Fleming St. Key West, FL 33040
Bay County Public Library 898 W. 11th St. Panama City, FL 32401
Walton County Library, Coastal Branch Library 437 Greenway Trail Santa Rosa Beach, FL 32459
West Florida Public Library, Southwest Branch 122248 Gulf Branch Hwy Pensacola, FL 32507
West Florida Public Library, Pensacola Library 239 North Spring St. Pensacola, FL 32502
Alabama
Ben May Main Library 701 Government St. Mobile, AL36602
Mississippi
Pascagoula Public Library 3214 Pascagoula St. Pascagoula, MS 39567
Louisiana
East Bank Regional Library 4747 West Napoleon Ave. Metairie, LA 70001
New Orleans Public Library, Main Library 219 Loyola Ave. New Orleans, LA 70112
Texas
Houston Public Library 500 Mickinney St. Houston, TX 77002
Corpus La Retema Central Library 805 Comanche Corpus Christi, TX 78401

8.4.4 Federally-Recognized Tribes

Electronic copies of the AFTT Draft and Final EIS/OEIS were sent to the federally-recognized tribes listed in Table 8.4-4.

Table 8.4-4: Federally-Recognized Tribes that Received the Draft and Final Environmental Impact Statement/Overseas Environmental Impact Statement

Federally-Recognized Tribes
Maine
Edward Peter Paul Tribal Chief Aroostook Band of Micmacs 7 Northern Rd. Presque Isle, ME 04769
Brenda Commander Tribal Chief Houlton Band of Maliseet Indians 88 Bell Rd. Littleton, ME 04730
William J. Nicholas Sr. Chief Passamaquoddy Tribe - Indian Township Reservation P.O. Box 301 Indian Township, ME 04668
Ralph E. Dana Tribal Chief Passamaquoddy Tribe at Pleasant Point Reservation P.O. Box 343 Perry, ME 04667-0343
Kirk Francis Tribal Chief Penobscot Nation 12 Wabanaki Way Indian Island, ME04468
Massachusetts
Cedric Cromwell Chairperson
Cheryl Andrews-Maltais Chairperson Wampanoag Tribe of Gay Head of Massachusetts 20 Black Brook Rd. Aquinnah, MA 02535
Rhode Island
Matthew Thomas Chief Sachem Narragansett Indian Tribe of Rhode Island P.O. Box 268 Charlestown, RI 02813-0268

Table 8.4-4. Federally-Recognized Tribes that Received the Draft and Final Environmental Impact Statement/Overseas Environmental Impact Statement (continued)

Connecticut
Rodney Butler Chairperson Mashantucket Pequot Indian Tribe P.O. Box 3180 Mashantucket, CT 06338-3130
Kevin Brown Chairperson Mohegan Indian Tribe of Connecticut 13 Crow Hill Rd. Uncasville, CT 06382
New York
Clint Halftown Council of Chiefs Cayuga Nation of New York 2540 SR-89 Seneca Falls, NY 13148
Ray Halbritter Nation Representative Oneida Nation of New York 5218 Patrick Rd. Verona, NY 13478
Council of Chiefs Onondaga Nation of New York 3951 Route 11 Nedrow, NY 13120
Beverly Cook Chief Saint Regis Mohawk Tribe 412 State Route 37 Akwesasne, NY 13655
Ron Lafrance Jr. Chief Saint Regis Mohawk Tribe 412 State Route 37 Akwesasne, NY 13655
Eric Thompson Chief Saint Regis Mohawk Tribe 412 State Route 37 Akwesasne, NY 13655
Todd Gates President Seneca Nation of Indians William Seneca Bldg. Irving, NY 14081

Table 8.4-4. Federally-Recognized Tribes that Received the Draft and Final Environmental Impact Statement/Overseas Environmental Impact Statement (continued)

Bryan Polite Chairperson Shinnecock Indian Nation P.O. Box 5006 Southampton, NY 11969-5006
Roger Hill Chief Tonawanda Band of Seneca Indians of New York 7027 Meadville Rd. Basom, NY 14013
Leo Henry Chief Tuscarora Nation of New York 5616 Walmore Rd. Lewiston, NY 14092
North Carolina
Patrick H. Lambert Principal Chief Eastern Band of Cherokee Indians of North Carolina P.O. Box 455 Cherokee, NC 28719-0460
South Carolina
Bill Harris Chief Catawba Indian Nation 996 Ave. of the Nations Rock Hill, SC 29730
Florida
Billy Cypress Chairperson Miccosukee Tribe of Indians of Florida Tamiami Station P.O. Box 440021 Miami, FL 33144
Marcellus Osceola Jr. Chairperson Seminole Tribe of Florida 6300 Stirling Rd. Hollywood, FL 33024
Paul Backhouse Tribal Historic Preservation Officer Seminole Tribe of Florida's Tribal Historic Preservation Officer 30290 Josie Billie Hwy. PMB-1003 Clewiston, FL 33440
Alabama
Stephanie A. Bryan Tribal Chair Poarch Band of Creek Indians of Alabama 5811 Jack Springs Rd. Atmore, AL 36502

Table 8.4-4. Federally-Recognized Tribes that Received the Draft and Final Environmental Impact Statement/Overseas Environmental Impact Statement (continued)

Mississippi
Phyllis J. Anderson Tribal Chief Mississippi Band of Choctaw Indians 101 Industrial Rd. Choctaw, MS 39350
Louisiana
O'Neil J. Darden Jr. Chairperson Chitimacha Tribe of Louisiana P.O. Box 661 Charenton, LA 70523-0661
Lovelin Poncho Chair Coushatta Tribe of Louisiana P.O. Box 818 Elton, LA 70532-0818
Cheryl Smith Chief Jena Band of Choctaw Indians P.O. Box 14 Jena, LA 71342-0014
Joey Barbry Chairperson Tunica-Biloxi Indian Tribe of Louisiana 151 Melacon Dr. Marksville, LA 71351
Texas
Bryant J. Celestine Historic Preservation Officer Alabama-Coushatta Tribe of Texas Historic Preservation Office Livingston, TX 77351
Clem Sylestine III Principal Chief Alabama-Coushatta Tribes of Texas 571 State Park Rd. 56 Livingston, TX 77351
Estavio Elizondo Menikapan Tribal Council Chairman Kickapoo Traditional Tribe of Texas P.O. Box 972 Eagle Pass, TX 78853-0972
Carlos Hisa Governor Ysleta Del Sur Pueblo of Texas P.O. Box 17579 El Paso, TX 79917-7579

Table 8.4-4. Federally-Recognized Tribes that Received the Draft and Final Environmental Impact Statement/Overseas Environmental Impact Statement (continued)

Oklahoma
Edwina Butler-Wolfe Governor Absentee Shawnee Tribe of Indians of Oklahoma 2025 South Gordon Cooper Shawnee, OK 74801
Kerry Holton President Delaware Nation P.O. Box 825 Anadarko, OK 73005
Chester Brooks Chief Delaware Tribe of Indians 5100 Tuxedo Blvd Bartlesville, OK 74006
Jodi Hayes Tribal Administrator Shawnee Tribe of Oklahoma P.O. Box 189 Miami, OK 74355
Wisconsin
Shannon Holsey Tribal President Stockbridge-Munsee Band of the Mohicans N8476 MoHeConNuck Road Bowler, WI 54416

8.5 Comments on the Draft EIS/OEIS

Comments on the Draft AFTT EIS/OEIS were received from 7 federal agencies, 31 state agencies, 7 local/regional government agencies, 5 nongovernmental organizations, 2 tribal governments, 1 commercial group, and 63 private individuals for a total of 116 comment submissions.

The 116 comment submissions were reviewed and categorized according to topic. Longer comments were broken down into multiple separate categories in order to properly and fully capture all of the different points within the letter (i.e., a comment may contain more than one theme within it). Comments were initially categorized into 21 categories based on their content As a result, the total number of comments the Navy responded to is much greater than the 116 comment submissions received. Appendix H (Public Comment Responses), contains a summary of the comments received on the AFTT Draft EIS/OEIS and the Navy's responses.

8.6 Notification of National Marine Fisheries Service Proposed Rule

National Marine Fisheries Service released its proposed rule; request for comment in the Federal Register on March 13, 2018. A correction to the proposed rule was listed in the Federal Register on April 9, 2018. The correction replaced Table 4 from the preamble with a corrected table. Copies of both Federal Register notices are included in Appendix G, Federal Register Notices.

This page intentionally left blank.