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

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3.7 Marine Vegetation

MARINE VEGETATION SYNOPSIS

The Navy considered all potential stressors and analyzed the following for marine vegetation:

- Acoustic (explosives)
- Physical disturbance and strike (vessels, in-water devices, military expended materials, and seafloor devices)
- Secondary stressors (sediment and water quality)

Regulatory Determinations for the Preferred Alternative

- Acoustics: Pursuant to the Endangered Species Act (ESA), the use of explosives will have no effect on ESA-listed Johnson's seagrass or its critical habitat.
- Physical Disturbance and Strike: Pursuant to the ESA, the use of vessels, in-water devices, military expended materials, and seafloor devices will have no effect on ESA-listed Johnson's seagrass or its critical habitat.
- Secondary: Pursuant to the ESA, secondary stressors will have no effect on ESA-listed Johnson's seagrass or its critical habitat.
- Pursuant to the Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, electromagnetic devices and contaminant stressors associated with training and testing activities will have no adverse impact on marine vegetation that constitutes Essential Fish Habitat or Habitat Areas of Particular Concern. Explosives and other impulsive sources, vessel movement, in-water devices, military expended materials, and seafloor devices associated with training and testing activities may have an adverse effect on Essential Fish Habitat by reducing the quality and quantity of marine vegetation that constitutes Essential Fish Habitat or Habitat Areas of Particular Concern.

3.7.1 Introduction

This section analyzes potential impacts on marine vegetation found in the Study Area. The species and taxonomic groups that occur in the Study Area are discussed in Section 3.7.1 (Introduction) and the baseline affected environment is discussed in Section 3.7.2 (Affected Environment). The analysis of environmental consequences is presented in Section 3.7.3 (Environmental Consequences) and the potential impacts of the Proposed Action are summarized in Section 3.7.4 (Summary of Potential Impacts on Vegetation).

For this Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS), marine vegetation is evaluated as groups of species characterized by their distribution. Training and testing activities of the United States (U.S.) Department of the Navy (Navy) are evaluated for their potential impacts on the one Endangered Species Act (ESA) listed species and six major taxonomic groups of marine vegetation, as appropriate (Table 3.7-1). Marine vegetation, including marine algae and flowering plants, is found throughout the Study Area. Marine vegetation species designated as Essential Fish Habitat under the Magnuson-Stevens Fishery Conservation and Management Act are described in the Essential Fish Habitat Assessment (U.S. Department of the Navy 2013), and conclusions from the Essential Fish Habitat Assessment are summarized in each substressor section.

The distribution and condition of abiotic (nonliving) substrate associated with attached macroalgae and the impact of stressors are described in Section 3.3 (Marine Habitats). Additional information on the biology, life history, and conservation of marine vegetation can be found on the websites of the following agencies and groups:

- National Marine Fisheries Service (NMFS), Office of Protected Resources (including ESA-listed species distribution maps)
- Conservation International
- Algaebase
- National Resources Conservation Service
- National Museum of Natural History

Table 3.7-1: Major Taxonomic Groups of Marine Vegetation in the Study Area

Marine Vegetation Groups		Vertical Distribution within Study Area[1]		
Common Name (Taxonomic Group)	**Description**	**Open Ocean Areas**	**Large Marine Ecosystem**	**Bays, Rivers, Estuaries**
Blue-green algae (phylum Cyanobacteria)	Many cyanobacteria form mats that attach to reefs.	Sea surface	Seafloor	Bottom
Dinoflagellates (phylum Dinophyta)	Most are single-celled, marine species of algae with two whip-like appendages (flagella). Some live inside other organisms, and some produce toxins.	Sea surface	Sea surface	Surface
Green algae (phylum Chlorophyta)	May occur as single-celled algae, filaments, and seaweeds.	Sea surface	Sea surface, seafloor	Surface, bottom
Diatoms, brown and golden-brown algae (phylum Ochrophyta)	Diatoms are single-celled algae. Brown and golden-brown algae are large multi-celled seaweeds.	Sea surface	Sea surface, seafloor	Surface, bottom
Red algae (phylum Rhodophyta)	Single-celled algae and multi-celled large seaweeds; some form calcium deposits.	Sea surface	Sea surface, seafloor	Surface, bottom
Seagrass, cordgrass, and mangroves (phylum Magnoliophyta)	Flowering plants (also called angiosperms) that are adapted to salty marine environments in mudflats and marshes.	None	Seafloor	Bottom

Source: (Bisby et al. 2010) for marine vegetation groups

[1] Vertical distribution in the Study Area is characterized by open-ocean oceanographic features (Labrador Current, Gulf Stream, and North Atlantic Gyre) or by coastal waters of large marine ecosystems (Caribbean Sea, Gulf of Mexico, Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf, and West Greenland Shelf).

3.7.1.1 Endangered Species Act Species

Johnson's seagrass (*Halophila johnsonii*) is listed as a threatened species under the ESA; it is the only species of marine vegetation listed. It occurs in the Study Area in the southern part of the Southeast U.S. Continental Shelf Large Marine Ecosystem. A discussion of this species is provided in Section 3.7.2.2 (Johnson's Seagrass [*Halophila johnsonii*]). The emphasis on species-specific information in the following sections is on the single ESA-listed species because any threats or potential impacts on Johnson's seagrass are subject to consultation with regulatory agencies.

3.7.1.2 Federally Managed Species

Sargassum fluitans and *Sargassum natans* (brown algae) are federally managed by the South Atlantic Fishery Management Council (Federal Register [FR] 68(192): 57375-57379, October 3, 2003). These species are considered, along with ESA-listed species and other taxonomic groupings, in the analysis of impacts in Section 3.7.3 (Environmental Consequences).

3.7.1.3 Taxonomic Groups

To cover all marine vegetation types represented in the Study Area, the major taxonomic groups are discussed in Section 3.7.2 (Affected Environment). The major taxonomic groups include five groups of marine algae and one group of flowering plants (Table 3.7-1).

3.7.2 AFFECTED ENVIRONMENT

Features that influence the distribution and abundance of marine vegetation in the large marine ecosystems and open ocean areas of the Study Area are the availability of light, water quality, water clarity, salinity level, seafloor type (important for rooted or attached vegetation), currents, tidal schedule, and temperature (Green and Short 2003). Marine ecosystems depend almost entirely on the energy produced by marine vegetation through photosynthesis (Castro and Huber 2000), which is the transformation of the sun's energy into chemical energy. In the lighted surface waters of the open-ocean and coastal waters, marine algae and flowering plants provide oxygen and habitat for many organisms in addition to forming the base of the marine food web (Dawes 1998).

The five major taxonomic groups of algae (dinoflagellates and blue-green, green, brown, and red algae) occur throughout the Study Area (Spalding et al. 2003). Algae distribution is shaped by water temperature differences that are directed by the Loop Current, Gulf Stream, and North Atlantic Gyre Open Ocean Areas (Spalding et al. 2003). The number of species and proportion of red, brown, and green algae vary along the coast of the Study Area. The overall number of species of red and green algae is higher than brown algae in the warmer waters of the Southeast U.S. Continental Shelf, Gulf of Mexico, and Caribbean Sea Large Marine Ecosystems. Brown algae species are more common in the colder waters of the Newfoundland-Labrador Shelf, Scotian Shelf, and Northeast U.S. Continental Shelf Large Marine Ecosystems (Dawes 1998). Some species of brown algae also occur in the Gulf Stream and North Atlantic Gyre Open Ocean Areas (Gower and King 2008; South Atlantic Fishery Management Council 2002).

The taxonomic group of marine vegetation that includes seagrass, cordgrass, and mangroves has more limited distributions; all of these occur in shallow (less than 26 m) water. The relative distribution of seagrass is influenced by the availability of suitable substrate in low-wave energy areas at depths that allow sufficient light exposure. Seagrass species distribution is influenced by water temperatures of the Loop Current, Florida Current, and Gulf Stream (Spalding et al. 2003). Cordgrasses form dense colonies in salt marshes that develop in temperate areas in protected, low-energy environments, along the intertidal portions of coastal lagoons, tidal creeks or rivers, or estuaries, wherever the sediment is adequate to support plant root development (Mitsch et al. 2009). Mangroves and cordgrasses have similar requirements, but mangroves are not tolerant of freezing temperatures. Their occurrence on the Atlantic coast of the United States is concentrated in tropical and subtropical waters with sufficient freshwater input.

The baseline description for marine vegetation in the Study Area, see Section 3.7.2 (Affected Environment), is based on references from scientific research and information published by regulatory agencies. In Section 3.7.3 (Environmental Consequences), the alternatives were evaluated based on the potential and the degree to which exposure to training and testing activities could impact marine vegetation.

3.7.2.1 General Threats

Environmental stressors on marine vegetation are products of human activities (industrial, residential, and recreational) and natural occurrences. The impacts of these environmental stressors on marine vegetation and the existing conditions of this resource are important to consider in determining if Navy training and testing activities contribute to these stressors. Species-specific information is discussed where applicable in Sections 3.7.2.2 (Johnson's Seagrass [*Halophila johnsonii*]) through 3.7.2.8 (Seagrasses, Cordgrasses, and Mangroves [Phylum Magnoliophyta]), and the cumulative impacts of these threats are analyzed in Chapter 4 (Cumulative Impacts).

Human-made stressors that act on marine vegetation include excessive nutrient input (pollutants, such as fertilizers), siltation (the addition of fine particles to the ocean), pollution (oil, sewage) (Mearns et al. 2011), climate change (Arnold et al. 2012; Doney et al. 2012; Martinez et al. 2012; Olsen et al. 2012), overfishing (Mitsch et al. 2009; Steneck et al. 2002), shading from structures (National Marine Fisheries Service 2002), habitat degradation from construction and dredging (National Marine Fisheries Service 2002), and invasion by exotic species (Hemminga and Duarte 2000; Spalding et al. 2003). The seagrass, cordgrass, and mangrove taxonomic group is more sensitive to stressors than the algal taxonomic groups. The great diversity of algae makes it difficult to generalize, but overall, they are resilient and are able to colonize disturbed environments created by stressors (Levinton 2009b).

Seagrasses, cordgrasses, and mangroves are all susceptible to the human-made stressors on marine vegetation, and their presence in the Study Area has decreased as a result. Each type of vegetation is sensitive to additional unique stressors. Seagrasses are uprooted by dredging, scarred by boat propellers (Hemminga and Duarte 2000; Spalding et al. 2003), and uprooted and broken by anchors (Francour et al. 1999). Seagrass that is uprooted from dredging or scarred from boat propellers can take years to regrow (Dawes et al. 1997). Sedimentation associated with severe storms can impact some seagrass populations, particularly those located near inlets. Degraded water quality also has the potential to damage seagrass by stimulating algal growth, which results in negative impacts on seagrass habitat such as shading (Thomsen et al. 2012). A review of seagrass from 1879 to 2006 found that global seagrass coverage decreased by 75 percent overall (Waycott et al. 2009). Cordgrasses are damaged by sinking salt marsh habitat; a process known as marsh subsidence. Areal coverage of cordgrasses in U.S. Atlantic and Gulf of Mexico salt marshes has decreased dramatically (Stedman and Dahl 2008). Likewise, the global mangrove resource decreased by 50 percent from aquaculture, changes in hydrology (water movement and distribution), and sea level rise (Feller et al. 2010).

A stressor of particular concern is oil pollution. Runoff from land-based sources, natural seeps, and accidental spills (such as off-shore drilling and oil tanker leaks) are some of the major sources of oil pollution in the marine environment (Levinton 2009a). The type and amount of oil spilled, weather conditions, season, location, oceanographic conditions, and the method used to remove the oil (containment or chemical dispersants) are some of the factors that determine the severity of the impacts. Sensitivity to oil varies among species and within species, depending on the life stage; generally, early life stages are more sensitive than adult stages (Hayes et al. 1992). The tolerance to oil pollutants varies among the types of marine vegetation, but their exposure to sources of oil pollutants makes them all vulnerable.

Oil pollution can impact seagrasses directly by smothering the plants, or indirectly by lowering their ability to combat disease and other stressors (U.S. National Response Team 2010). Seagrasses that are totally submerged are less susceptible to oil spills since they largely escape direct contact with the pollutant. Depending on various factors, oil spills can result in a range of effects from no impact to long-lasting impacts, such as decreases in eelgrass density (Kenworthy et al. 1993; Peterson 2001). Algae are relatively resilient to oil spills, while mangroves are highly sensitive to oil exposure. Contact with oil can cause death, leaf loss, and failure to germinate (Hoff et al. 2002). Salt marshes (e.g., cordgrass) can also be severely impacted by oil spills, and the effects can be long-term (Culbertson et al. 2008).

The following section provides information on the ESA-protected species of marine vegetation and descriptions of the major marine vegetation taxonomic groupings listed in Table 3.7-1. Basic descriptions of each group and their ecosystem services roles, along with examples of representative species within the Study Area are discussed.

The discussion above represents general threats to marine vegetation. Additional threats to individual species within the Study Area are described below in the accounts of those species.

3.7.2.2 Johnson's Seagrass (*Halophila johnsonii*)

3.7.2.2.1 Status and Management

In 1998, Johnson's seagrass was the first marine plant species to be designated as federally threatened under the ESA by NMFS (FR 63(117): 49035-49041, September 14, 1998). In 2000, 10 areas in southeast Florida were designated as critical habitat (FR 65(66): 17786-17804, April 5, 2000); see Figure 3.7-1. The primary constituent elements of the critical habitat areas are "adequate water quality, salinity levels, water transparency, and stable, unconsolidated sediments that are free from physical disturbance" (FR 65(66): 17786-17804, April 5, 2000). Designated critical habitat areas also fulfill one or more of the following five criteria (FR 65(66): 17786-17804, April 5, 2000):

- Locations with populations that have persisted for 10 years
- Locations with persistent flowering plant populations
- Locations at the northern and southern range limits of the species
- Locations with unique genetic diversity
- Locations with a documented high abundance of Johnson's seagrass compared to other areas in the species' range

3.7.2.2.2 Habitat and Geographic Range

The preferred habitat for Johnson's seagrass is coastal lagoons and bays, from the area covered at high tide to depths of up to 9.8 ft. (3 m) (National Marine Fisheries Service 2002). It is found year-round in sediments of loose sand and silt-clay in beds with other species of seagrass (Creed et al. 2003; Eiseman and McMillan 1980).

The documented geographic range of Johnson's seagrass does not co-occur with the Study Area but occurs near the Study Area in the Southeast U.S. Continental Shelf Large Marine Ecosystem. This species is not found in any other large marine ecosystem or in any open ocean areas. It is reported to occur between Sebastian Inlet (Indian River Lagoon) and Biscayne Bay on the southeast coast of Florida in lagoons and bays (Florida Department of Environmental Protection 2010a; National Marine Fisheries Service 2002). Critical habitat areas occur in parts of the Indian River Lagoon and Biscayne Bay in Florida. A recent study reported Johnson's seagrass north of Sebastian Inlet, which extends the northern limit of this species by 11.5 nautical miles (nm); the extension is considered temporary and only expected to occur under favorable conditions (Virnstein and Hall 2009).

No training or testing activities are proposed in the lagoons or bays where Johnson's seagrass occurs and they do not overlap with the critical habitat of this species. The Jacksonville (JAX) Operating Area (OPAREA) and the South Florida Ocean Measurement Facility Testing Range are the closest Navy training and testing areas to the distribution of Johnson's seagrass. Taking the northern extension into consideration, the northern limit for Johnson's seagrass is estimated to be 45 nm away from the southern border of the JAX OPAREA. The South Florida Ocean Measurement Facility Testing Range is less than 2 nm away from Johnson's seagrass critical habitat.

3.7.2.2.3 Population and Abundance

There are an estimated 502,000 acres (ac.) (203,155 hectares [ha]) of Johnson's seagrass between Sebastian Inlet and Biscayne Bay, Florida (Florida Department of Environmental Protection 2010a; National Marine Fisheries Service 2002). Population and abundance trends for this species are difficult to approximate due to its fairly recent identification as a distinct species (Eiseman and McMillan 1980), short-lived nature, and rareness of quantitative population data (Creed et al. 2003; National Marine Fisheries Service 2010; Virnstein et al. 2009). Since the 1970s, seagrass species have decreased by approximately 50 percent in the Indian River Lagoon, which constitutes a large part of the range for Johnson's seagrass (Woodward-Clyde Consultants 1994). This decline of seagrasses in the Indian River Lagoon was likely due to human impacts on water quality and marine substrates (Woodward-Clyde Consultants 1994). Compared to other seagrasses within its range in the Indian River area (Hobe Sound, Jupiter Sound, and Ft. Pierce Inlet), Johnson's seagrass is the least abundant (Virnstein and Hall 2009; Virnstein et al. 1997).

3.7.2.2.4 Species-Specific Threats

Johnson's seagrass is vulnerable to the threats to seagrasses discussed in Section 3.7.2.1 (General Threats). This species is especially vulnerable to these threats because of its limited distribution and reproductive capability (no seed production), which result in its limited potential for recovery (National Marine Fisheries Service 2002).

3.7.2.3 Blue-Green Algae (Phylum Cyanobacteria)

Blue-green algae include single-celled and filamentous (fine-threads) forms of photosynthetic (using the sun's energy to produce food) bacteria that inhabit the lighted surface water and seafloor of the world's oceans (Bisby et al. 2010). More than 1,000 species of blue-green algae occur in the Study Area (Castro and Huber 2000). Zooplankton (free-floating organisms) feed on blue-green algae at the sea surface and in the water column, and grazing organisms (e.g., molluscs: chitons and limpets) feed on blue-green algae on the seafloor. Blue-green algae occur in all large marine ecosystems, open ocean areas, and inland waters (e.g., lower Chesapeake Bay, Narragansett Bay, and St. Andrew Bay) of the Study Area. Common species of blue-green algae that occur in the Study Area are *Microcystis aeruginosa* and members of the genus *Synechococcus*.

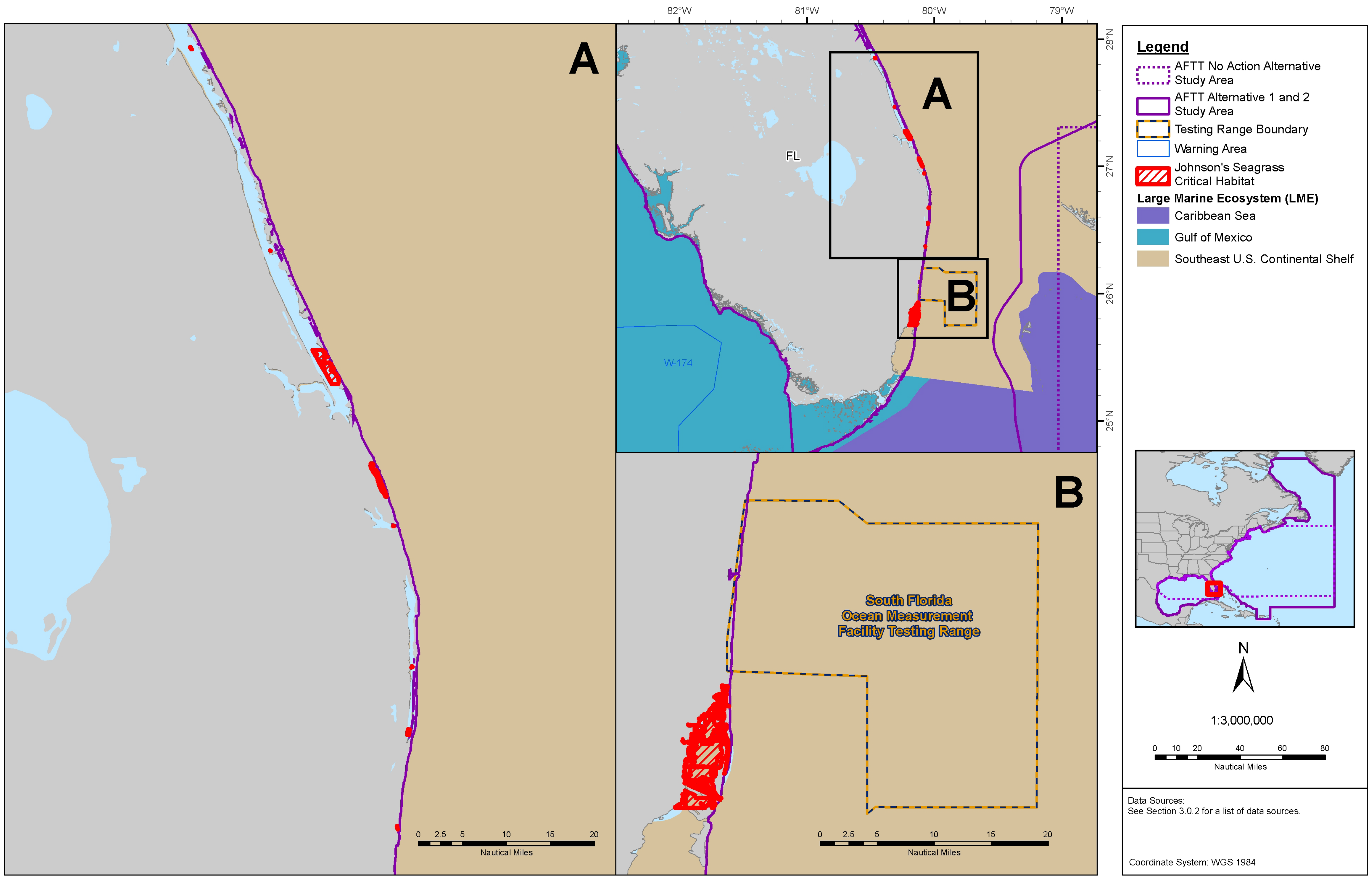

Figure 3.7-1: Critical Habitat Areas for Johnson's Seagrass Adjacent to the Study Area
AFTT: Atlantic Fleet Training and Testing; FL: Florida

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3.7.2.4 Dinoflagellates (Phylum Dinophyta)

Dinoflagellates are single-celled, predominantly marine algae (Bisby et al. 2010). Thousands of species live in the surface waters of the Study Area (Castro and Huber 2000). Most dinoflagellates are photosynthetic, and many can also ingest small food particles. They occur in all large marine ecosystems, open ocean areas, and inland waters of the Study Area. Organisms such as zooplankton feed on dinoflagellates. Dinoflagellates are responsible for some types of harmful algal blooms caused by sudden increases of nutrients (e.g., fertilizers) from land into the ocean or changes in temperature and sunlight (Levinton 2009c). Additional information on harmful algal blooms can be accessed on the Centers for Disease Control and the National Oceanic and Atmospheric Administration websites. Common species of dinoflagellates that occur in the Study Area are *Polysphaeridium zoharyi* and *Tectatodinium pellitum* (Marret and Zonneveld 2003).

3.7.2.5 Green Algae (Phylum Chlorophyta)

Green algae include single-celled and multi-celled types that form sheets or branched structures (Bisby et al. 2010). These multi-celled types of green algae are referred to as macroalgae (National Oceanic and Atmospheric Administration 2011). Hundreds of marine species of green algae are common in well-lit, shallow water. Green macroalgae and some single-celled algae are found attached to the seafloor or in sediments in all of the large marine ecosystems and inland waters of the Study Area (Levinton 2009c). Other types of green single-celled algae are planktonic (float freely in the ocean) and are found in the surface waters of the open ocean areas of the Study Area in addition to the areas where the macroalgae occur. Green algae species are eaten by various organisms, including zooplankton and snails. Some common species of green algae that occur in the Study Area are sea lettuce (*Ulva lactuca*) and members of the genus *Enteromorpha*.

3.7.2.6 Diatoms and Brown Algae (Phylum Ochrophyta)

Diatoms are primarily planktonic, single-celled organisms with cell walls made of silica (Castro and Huber 2000). Approximately 6,000 species of diatoms are marine organisms. Most species are found in the lighted areas, the upper 200 m of the water column (see Figure 3.0-5 in Section 3.0.3.2, Bathymetry), of the sea surface in the open ocean areas of the Study Area. Zooplankton feed on diatoms. Brown algae are predominately marine species with structures varying from fine filaments to thick leathery forms (Castro and Huber 2000). Most species are attached to the seafloor in coastal waters, although a free-floating type of brown algae (*Sargassum*) occurs in the Study Area. Two types of brown macroalgae that occur in the Study Area are kelp (*Laminaria* spp.) and *Sargassum* spp.

Kelp

Kelp is represented by three macroalgae species in the Study Area: *Laminaria saccharina, Laminaria longicruris*, and *Laminaria digitata* (Egan and Yarish 1988). Kelp are anchored to hard surfaces on the seafloor (Levinton 2009b). These kelp species occur from the low tide line out to depths as great as 65 ft. (20 m) depending on the water clarity (Luning 1990; Steneck et al. 2002) along the rocky, northwest Atlantic shores in large subtidal stands where sufficient nutrients are available (Vadas et al. 2004). In the Study Area, *Laminaria* spp. occur from Greenland to Long Island in the Newfoundland-Labrador Shelf and Scotian Shelf Large Marine Ecosystems, and in the northern part of the Northeast U.S. Continental Shelf Large Marine Ecosystem (Mathieson et al. 2009; Steneck et al. 2002). In Long Island Sound, the most extensive population is in Black Ledge, Groton, Connecticut (Egan and Yarish 1990); this location is also the southern limit for kelp in the Study Area. Organisms such as sea urchins and crustaceans feed on kelp (Steneck et al. 2002).

Sargassum

The dominant open-ocean species of *Sargassum* in the Study Area are *Sargassum natans* and *Sargassum fluitans* (hereafter collectively referred to as *Sargassum*). These species float freely on the sea surface and grow in clumps and mats (Coston-Clements et al. 1991). Accumulations of *Sargassum* are vital to some species and economically important to commercial fisheries and other industries. It provides foraging areas and habitat for marine organisms (e.g., sea turtles, birds, and fish) and raw materials for fertilizers and medicines (South Atlantic Fishery Management Council 2002). See Sections 3.5 (Sea Turtles and Other Marine Reptiles), 3.6 (Birds), and 3.9 (Fish) for more information.

Harvesting too much *Sargassum* is a threat to this resource (McHugh 2003; Trono and Tolentino 1993). To maintain this resource, *Sargassum* is managed under the Fishery Management Plan for Pelagic *Sargassum* Habitat of the South Atlantic Region due to its importance as Essential Fish Habitat for numerous species (South Atlantic Fishery Management Council 2002).

In the Study Area, *Sargassum* is widely distributed in the Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Caribbean Sea, and Gulf of Mexico Large Marine Ecosystems, and in the Gulf Stream and North Atlantic Gyre Open Ocean Areas. In the North Atlantic, *Sargassum* occurs mainly within the physical bounds of the North Atlantic Gyre Open Ocean Area, between latitudes 20° N and 40° N, and between longitude 30° W and the western edge of the Gulf Stream—a region known as the Sargasso Sea (Gower et al. 2006; South Atlantic Fishery Management Council 2002). Some exchange occurs among the *Sargassum* populations in the Caribbean Sea, Gulf of Mexico, and the North Atlantic. Recent satellite image evidence suggests that *Sargassum* originates in the northwest Gulf of Mexico every spring and is moved into the Atlantic east of Cape Hatteras in late summer by the Loop Current and Gulf Stream, and later appears northeast of the Bahamas in the beginning of the next year (Gower and King 2008). See Section 3.0.3.3 (Currents, Circulation Patterns, and Water Masses) for more information on the Loop Current and Gulf Stream.

The difficulty of tracking and sampling *Sargassum* makes acquiring information about its distribution and abundance difficult. Estimates based on towed net samples for the North Atlantic range from 4.4 to 12 million U.S. tons (4 to 11 billion kg) (Butler et al. 1983; South Atlantic Fishery Management Council 2002). A more recent estimate based on satellite imaging data puts the average total mass of *Sargassum* at 2 million U.S. tons (1.8 billion kg) in the Gulf of Mexico and the Atlantic (1 million U.S. tons [900 million kg] in each) (Gower and King 2008). Using the low and high abundance estimates (2 million U.S. tons [1.8 billion kg] to 12 million U.S. tons [11 billion kg]) and a conversion factor of 25 grams per square meter of *Sargassum* (Gower et al. 2006), approximately 21,000 nm^2 to 130,000 nm^2 of the Study Area is covered by *Sargassum*. Given the size of the Study Area (approximately 2.6 million nm^2), the relative coverage of *Sargassum* ranges from less than 1 percent to 5 percent of the sea surface.

3.7.2.7 Red Algae (Phylum Rhodophyta)

Red algae are predominately marine, with approximately 4,000 species of microalgae and macroalgae worldwide (Castro and Huber 2000). Red macroalgae species have various forms from fine filaments to thick calcium carbonate crusts and require a surface to attach to such as hard bottom or another plant. Red macroalgae and some microalgae species are found attached to the seafloor or on sediment, respectively, in all of the large marine ecosystems and the inland waters of the Study Area (Adey and Hayek 2011; Levinton 2009b). Planktonic microalgae are present in the surface waters of the open ocean areas of the Study Area in addition to the areas where the macroalgae occur. Some common species of red algae that occur in the Study Area are in the genus *Lithothamnion* (crustose coralline algae). Red algae are a food source for various zooplankton, sea urchins, fishes, and chitons.

3.7.2.8 Seagrasses, Cordgrasses, and Mangroves (Phylum Magnoliophyta)

Seagrasses

The nine species of seagrass that occur within the Study Area are listed in Table 3.7-2 (Spalding et al. 2003). Seagrasses are unique among flowering plants in their ability to grow submerged in shallow marine environments. Seagrasses grow predominantly in shallow, subtidal, or intertidal sediments sheltered from wave action in estuaries, lagoons, and bays (Phillips and Meñez 1988) and can extend over a large area to form seagrass beds (Garrison 2004; Gulf of Mexico Program 2004; Phillips and Meñez 1988). Seagrasses, including ESA-listed Johnson's seagrass, serve as a food source for numerous species (e.g., green sea turtles, West Indian manatees, and various plant-eating fishes) (Heck et al. 2003; National Marine Fisheries Service 2002; National Oceanic and Atmospheric Administration 2001).

Seagrasses occur in all Atlantic and Gulf of Mexico coastal states, except for Georgia and South Carolina (Fonseca et al. 1998). In the Study Area, seagrasses grow at a minimum depth of 0.2 m (0.66 ft.) to a maximum depth of 26.5 m (86.9 ft.) (Ferguson and Wood 1994; Florida Department of Environmental Protection 2010b; Fourqurean et al. 2002). Depth limits for seagrasses in inland portions of the Study Area are 6 m (19.7 ft.) in Narragansett Bay (Narragansett Bay Estuary Program 2010), 1 m (3.2 ft.) in Chesapeake Bay (Orth and Moore 1988), and 2.4 m (7.9 ft.) in St. Andrew Bay (Florida Department of Environmental Protection 2010b). The largest area of seagrass in the Study Area occurs in the Gulf of Mexico Large Marine Ecosystem, followed by the Southeast U.S. Continental Shelf, and the Northeast U.S. Continental Shelf Large Marine Ecosystems (Spalding et al. 2003).

Table 3.7-2: Presence of Seagrass Species within the Study Area

Seagrass Species	Presence in the Study Area[1]
Clover grass (*Halophila baillonii*)	Gulf of Mexico, Caribbean Sea
Eelgrass (*Zostera marina*)	West Greenland Shelf, Newfoundland-Labrador Shelf, Scotian Shelf, Northeast U.S. Continental Shelf
Engelmann's seagrass (*Halophila engelmannii*)	Southeast U.S. Continental Shelf, Gulf of Mexico, Caribbean Sea
Johnson's seagrass (*Halophila johnsonii*)	Southeast U.S. Continental Shelf, Caribbean Sea
Manatee grass (*Syringodium filiforme*)	Southeast U.S. Continental Shelf, Gulf of Mexico, Caribbean Sea
Paddle grass (*Halophila decipiens*)	Southeast U.S. Continental Shelf, Gulf of Mexico, Caribbean Sea
Shoal grass (*Halodule wrightii*)	Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Gulf of Mexico, Caribbean Sea
Turtlegrass (*Thalassia testudinum*)	Southeast U.S. Continental Shelf, Gulf of Mexico, Caribbean Sea
Widgeon grass (*Ruppia maritima*)	Newfoundland-Labrador Shelf, Scotian Shelf, Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Gulf of Mexico, Caribbean Sea

Source: (Spalding et al. 2003)

[1] Presence in the Study Area indicates the coastal waters of large marine ecosystems (Gulf of Mexico, Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Caribbean Sea, Scotian Shelf, Newfoundland-Labrador Shelf, and West Greenland Shelf) in which the species are found.

Cordgrasses

The most common species of cordgrass in the Study Area is known as smooth or salt-marsh cordgrass (*Spartina alterniflora*) (Mitsch et al. 2009). Cordgrasses and other emergent marsh species are salt-tolerant, moderate-weather (temperate) species and an integral component of salt marsh vegetation. Salt marshes develop in intertidal, protected low-energy environments, usually in coastal lagoons, tidal creeks or rivers, or estuaries (Mitsch et al. 2009).

Salt marsh is the dominant coastal wetland type along much of the Atlantic and gulf coasts of the United States. Cordgrasses occur in salt marshes from Maine to Florida, and along the Gulf of Mexico from Louisiana to Texas (Mitsch et al. 2009). Most salt marsh coverage in the Study Area is concentrated in the Gulf of Mexico Large Marine Ecosystem, covering an estimated 2,498,225 ac. (1,011,000 ha), while an additional 1,653,130 ac. (669,000 ha) of salt marsh occurs in the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems (Watzin and Gosselink 1992).

Mangroves

Mangroves are a group of woody plants that have adapted to brackish water environments (where salt water and freshwater mix) (Ruwa 1996). Mangroves inhabit marshes and mudflats in tropical and subtropical areas. Within the Study Area, three mangrove species occur in the Southeast U.S. Continental Shelf and Gulf of Mexico Large Marine Ecosystems (Table 3.7-3) (Spalding et al. 2013). Mangroves occur from Cedar Key to Cape Canaveral, Florida (Mitsch et al. 2009). The northern limit for mangroves in Florida is St. Augustine. The largest continuous tract of mangrove forest in the Study Area is found in the Florida Everglades system (U.S. Geological Survey 2003).

Table 3.7-3: Presence of Mangrove Species in the Study Area

Mangrove Species	Presence in the Study Area[1]
Red mangrove (*Rhizophora mangle*)	Southeast U.S. Continental Shelf, Gulf of Mexico, Caribbean Sea
Black mangrove (*Avicennia germinans*)	Southeast U.S. Continental Shelf, Gulf of Mexico, Caribbean Sea
White mangrove (*Laguncularia racemosa*)	Southeast U.S. Continental Shelf, Gulf of Mexico, Caribbean Sea

Sources: (Ellison et al. 2007a, b, c)

[1] Presence in the Study Area indicates the coastal waters of large marine ecosystems (Gulf of Mexico, Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Caribbean Sea, Scotian Shelf, Newfoundland-Labrador Shelf, and West Greenland Shelf) in which the species are found.

3.7.3 Environmental Consequences

This section evaluates how and to what degree the activities described in Chapter 2 (Description of Proposed Action and Alternatives) potentially impact marine vegetation. General characteristics of all Navy stressors were introduced in Section 3.0.5.3 (Identification of Stressors for Analysis), and living resources' general susceptibilities to stressors were introduced in Section 3.0.5.7 (Biological Resource Methods). Each marine vegetation stressor is introduced, analyzed by alternative, and analyzed for training and testing activities. Table F-3 in Appendix F (Training and Testing Activities Matrices) shows the warfare areas and associated stressors that were considered for analysis of marine vegetation.

The stressors vary in intensity, frequency, duration, and location within the Study Area. Based on the general threats to marine vegetation discussed in Section 3.7.2 (Affected Environment) the stressors applicable to marine vegetation are:

- Acoustic (explosives)
- Physical disturbance and strike (vessels, in-water devices, military expended materials, seafloor devices)
- Secondary stressors (sediment and water quality)

Given that marine vegetation is not susceptible to energy, entanglement, or ingestion stressors they will not be assessed. Only the Navy training and testing activity stressors and their components that occur in the same geographic location as marine vegetation are analyzed in this section. Training and testing activities pose no direct threat to some types of marine vegetation habitats. For example, mangroves and emergent marsh species, including cordgrass species, border parts of the Study Area and some naval ports and shipyards and transit channels, but do not overlap with Navy training and testing activities. Because the potential for Navy activities to directly impact these marine vegetation types is remote, they are evaluated only for secondary stressors. Although the ESA-listed species, Johnson's seagrass, does not occur in any of the Study Area locations where training and testing activities occur (see Section 3.7.2.2.2, Habitat and Geographic Range), given the proximity of its critical habitat to the South Florida Ocean Measurement Facility Testing Range, potential impacts to this species are considered in the analysis. Details of all training and testing activities, stressors, components that cause the stressor, and geographic occurrence within the Study Area, are summarized in Section 3.0.5.3 (Identification of Stressors for Analysis) and detailed in Appendix A (Navy Activities Descriptions).

3.7.3.1 Acoustic Stressors

This section analyzes the potential impacts of acoustic stressors that may occur during Navy training and testing activities on marine vegetation within the Study Area. The acoustic stressors that may impact marine vegetation include explosives that are detonated on or near the surface of the water, or underwater; therefore, only these types of explosions are discussed in this section.

3.7.3.1.1 Impacts from Explosives

There are various types of explosives that are used during training and testing activities. A discussion of the type, number, and location of activities that use explosives under each alternative is presented in Section 3.0.5.3.1.2 (Explosives). Explosive sources are the only acoustic stressor applicable to this resource because of the potential for explosives to result in physical damage to marine vegetation.

In areas where marine vegetation overlaps with locations for explosions, the vegetation that may be impacted occurs on the surface of the water, in the water column, or rooted in the seafloor. Single-celled algae may overlap with underwater and sea surface explosion locations. If single-celled algae are in the immediate vicinity of an explosion, only a small number of them are likely to be impacted relative to their total population level. The low number of explosions on or near the bottom relative to the amount of single-celled algae in the Study Area also decreases the potential for impacts. The impact on single-celled algae would not be detectable; therefore, it will not be discussed further.

Macroalgae attached to the seafloor, floating *Sargassum,* and seagrasses may all occur in locations where explosions are conducted and may be adversely impacted for different reasons. Attached macroalgae grow quickly and are resilient to high levels of wave action (Mach et al. 2007), which may aid in their ability to recover from and withstand wave action caused by underwater explosions near them on the seafloor. Floating *Sargassum* is more resilient to physical disturbance than seagrass, but there are more explosions on or near the surface where they co-occur. Seagrasses, including ESA-listed Johnson's seagrass, take longer to recover from physical disturbance than macroalgae, despite the relatively low number of explosions on or near the bottom where they co-occur. For these reasons, only attached macroalgae, *Sargassum,* and seagrasses are analyzed further for potential impacts of explosions. Neither the ESA-listed species Johnson's seagrass, nor its critical habitat, overlap with the Study Area; however, an analysis of potential impacts is included due to its proximity to training and testing activity areas.

The potential for impacts to marine vegetation from explosions would depend on the presence and amount of vegetation, the depth of the explosion, the number of explosives used, and their net explosive weight. Attached macroalgae need hard or artificial substrate in order to grow. The distribution of attached macroalgae is inferred by the presence of hard or artificial substrate that occurs at depths of less than 200 m throughout the Study Area; see Section 3.3.2.6 (Hard Bottoms) for information regarding the distribution of hard substrate in the Study Area. If attached macroalgae are in the immediate vicinity of an explosion, only a small number of them are likely to be impacted relative to their total population level.

Sargassum distribution is difficult to predict (Gower and King 2008; South Atlantic Fishery Management Council 2002) and it may overlap with any of the locations where sea surface and underwater explosions are conducted. In the Study Area, the relative coverage of *Sargassum* is very low ranging from less than 1 percent to 5 percent of the sea surface; see Section 3.7.2.6 (Diatoms and Brown Algae [Phylum Ochrophyta]) for details. *Sargassum* may be impacted by surface disturbances from underwater or sea surface explosions, although *Sargassum* is resilient to natural conditions caused by wind, wave action, and severe weather that may break apart pieces of the mat or cause the mats to sink. In the unlikely situation that a *Sargassum* mat is broken by an explosion, the broken pieces may develop into new *Sargassum* mats because *Sargassum* reproduces by vegetative fragmentation (new plants develop from pieces of the parent plant) (South Atlantic Fishery Management Council 1998). Impacts to *Sargassum* from underwater explosions may potentially collapse the pneumatocysts (air sacs) that keep the mats floating at the surface. Evidence suggests that *Sargassum* will remain floating even when up to 80 percent of the pneumatocysts are removed (Zaitsev 1971). So even if an explosion caused the collapse of most of a *Sargassum* mat's pneumatocysts, it may not cause it to sink. Since the occurrence of *Sargassum* is an indicator of marine mammal and sea turtle presence, some mitigation measures designed to reduce impacts on these resources may indirectly reduce impacts on *Sargassum;* see Section 5.3.2.1.2 (Explosives and Impulsive Sound). Explosions could cause injury to the organisms that inhabit *Sargassum*. See Sections 3.4 (Marine Mammals), 3.5 (Sea Turtles and Other Marine Reptiles), 3.8 (Marine Invertebrates), and 3.9 (Fish) for the assessment of impacts from explosions on these resources.

The potential for seagrass to overlap with underwater and surface explosions is limited to the Key West Range Complex based on relevant mapping data, see Figure 3.7-2 (Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute 2012). Seagrasses may potentially be uprooted or damaged by sea surface or underwater explosions. They are much less resilient to disturbance relative to *Sargassum*; regrowth after uprooting can take up to 10 years (Dawes et al. 1997). Explosions may also temporarily increase the turbidity (sediment suspended in the water) of nearby waters, but the sediment would settle to pre-explosion conditions within a number of days. Sustained high levels of turbidity may reduce the amount of light that reaches vegetation which it needs to survive. This scenario is not likely given the low number of explosions planned in areas with seagrass. It should be noted that seagrasses generally grow in waters that are sheltered from wave action, such as estuaries, lagoons, and bays (Phillips and Meñez 1988) where most activities are not conducted.

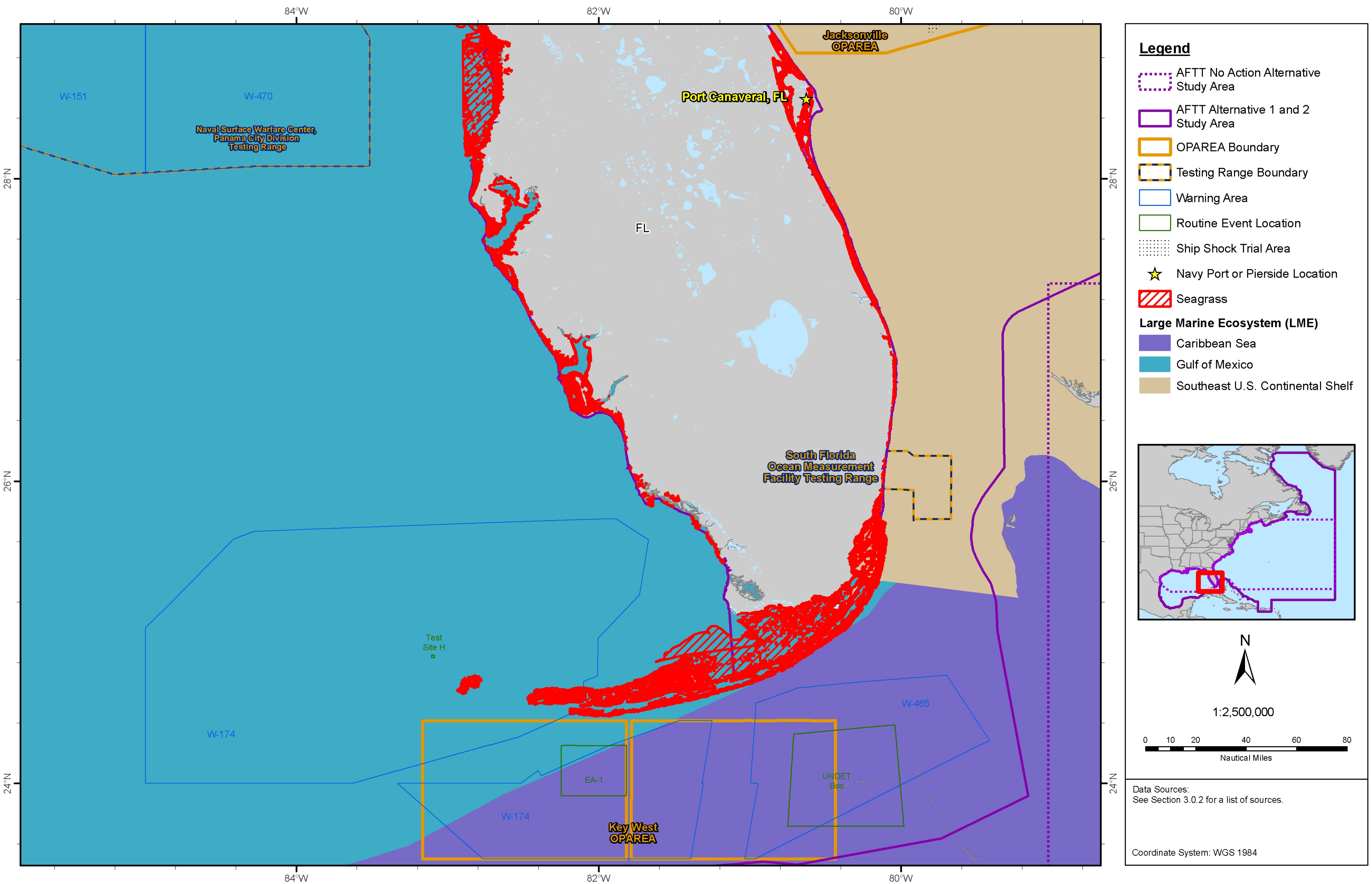

Figure 3.7-2: Seagrass Occurrence in South Florida

AFTT: Atlantic Fleet Training and Testing; FL: Florida; OPAREA: Operating Area; UNDET: Underwater Detonation

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3.7.3.1.1.1 No Action Alternative

Training Activities

Section 3.0.5.3.1.2 (Explosives) contains information regarding the location and number of explosives detonated in the Study Area. Under the No Action Alternative, underwater and surface explosions occur in the Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems. The majority of training activities involving explosions would be conducted in the Northeast U.S. Continental Shelf Large Marine Ecosystem in the Virginia Capes (VACAPES) Range Complex. Explosions would also be conducted in the JAX, Navy Cherry Point, Gulf of Mexico (GOMEX), and Northeast Range Complexes, and Other AFTT Areas. Training activities using explosions generally do not occur within 3 nm of shore. In addition, the majority of underwater explosions in the Study Area would likely occur over unvegetated seafloor because it is the predominant bottom-type in the areas proposed for these activities. However, marine vegetation such as attached macroalgae and *Sargassum* may overlap with underwater explosions (Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute 2012; U.S. Fish and Wildlife Service 2012). The total population of attached macroalgae is high relative to the small number likely to be impacted by underwater explosions. *Sargassum* distribution is patchy and difficult to predict (Gower and King 2008; South Atlantic Fishery Management Council 2002), but it may overlap with some of the training locations identified under the No Action Alternative where surface explosions may occur, see Table 3.0-13. However, the estimated distribution of *Sargassum* in the Study Area ranges from 21,000 nm^2 to 130,000 nm^2.

Under the No Action Alternative, seagrasses are absent from all of the locations for underwater and surface explosions based on marine vegetation maps (National Coastal Data Development Center and National Oceanic and Atmospheric Administration 2012; North Carolina Department of Environmental and Natural Resources 2012).

There is no overlap of underwater or surface explosions with designated critical habitat for Johnson's seagrass. Primary constituent elements may occur in locations that have not been designated as critical habitat but Johnson's seagrass critical habitat must meet at least one of five additional criteria (Section 3.7.2.2.1, Status and Management). The Study Area does not meet any of the additional criteria; therefore, underwater and sea surface explosions will not affect Johnson's seagrass critical habitat.

Underwater and surface explosions conducted for training activities are not expected to cause any risk to *Sargassum,* attached macroalgae or seagrass because: (1) the large distribution of *Sargassum* in the Study Area, (2) new growth may result from *Sargassum* exposure to explosives, (3) only a small number of attached macroalgae would be impacted, and (4) seagrass does not overlap with areas where the stressor occurs. Based on these factors, potential impacts to *Sargassum* and attached macroalgae from surface explosions are not expected to result in detectable changes to their growth, survival, or propagation, and are not expected to result in population-level impacts; and there are no potential impacts to seagrass.

Pursuant to the ESA, the use of explosives during training activities as described under the No Action Alternative:

- *will have no effect on ESA-listed Johnson's seagrass and*
- *will have no effect on Johnson's seagrass critical habitat.*

Testing Activities

Section 3.0.5.3.1.2 (Explosives) contains information regarding the location and number of explosives detonated in the Study Area. Under the No Action Alternative, underwater and surface explosions occur in the Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems, specifically within the VACAPES Range Complex; JAX Range Complex; Panama City OPAREA; and Naval Surface Warfare Center, Panama City Division Testing Range. Testing activities using explosions generally do not occur within 3 nm of shore. In addition, the majority of underwater explosions in the Study Area would likely occur over unvegetated seafloor because it is the predominant bottom-type in the areas proposed for these activities; however, some types of marine vegetation may overlap with underwater explosions.

Sargassum distribution is patchy and difficult to predict, but it may overlap with some of the testing locations identified under the No Action Alternative where surface explosions may occur (see Table 3.0-13). As discussed under the No Action Alternative for training activities, attached macroalgae may occur in testing locations and the estimated distribution of *Sargassum* in the Study Area is relatively wide.

Seagrasses are absent from all of the testing locations for underwater and surface explosions based on the general practice of excluding explosions from areas where seagrasses predominantly grow (e.g., bays, rivers, and estuaries) (Section 3.7.2.8, Seagrasses, Cordgrasses, and Mangroves [Phylum Magnoliophyta]), and relevant marine vegetation maps (National Coastal Data Development Center and National Oceanic and Atmospheric Administration 2012; North Carolina Department of Environmental and Natural Resources 2012).

There is no overlap of underwater or surface explosions with designated critical habitat for Johnson's seagrass. Primary constituent elements may occur in locations that have not been designated as critical habitat but Johnson's seagrass critical habitat must meet at least one of five additional criteria (Section 3.7.2.2.1, Status and Management). The Study Area does not meet any of the additional criteria; therefore, underwater and surface explosions will not affect Johnson's seagrass critical habitat.

Underwater and surface explosions conducted for testing activities are not expected to cause any risk to *Sargassum,* attached macroalgae, or seagrass because: (1) the large distribution of *Sargassum* in the Study Area, (2) new growth may result from *Sargassum* exposure to explosives, (3) only a small number of attached macroalgae would be impacted, and (4) seagrass does not overlap with areas where the stressor occurs. Based on these factors, potential impacts to *Sargassum* and attached macroalgae from surface explosions are not expected to result in detectable changes to their growth, survival, or propagation, and are not expected to result in population-level impacts; and there are no potential impacts to seagrass.

Pursuant to the ESA, the use of explosives during testing activities as described under the No Action Alternative:

- *will have no effect on ESA-listed Johnson's seagrass and*
- *will have no effect on Johnson's seagrass critical habitat.*

3.7.3.1.1.2 Alternative 1

Training Activities

Under Alternative 1, underwater and surface explosions conducted in the Study Area would increase by two-fold over the No Action Alternative (Section 3.0.5.3.1.2, Explosives). As under the No Action Alternative, training activities would continue to occur in the Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems. Also, most underwater explosions would be conducted in the VACAPES Range Complex in the Northeast U.S. Continental Shelf Large Marine Ecosystem. Under Alternative 1, activities would be introduced in the Key West Range Complex in the Gulf of Mexico Large Marine Ecosystem.

The potential impacts on *Sargassum* and attached macroalgae from exposure to surface explosions are as described in Section 3.7.3.1.1.1 (No Action Alternative). As discussed, the expected impact is small relative to the distribution of *Sargassum* and attached macroalgae in the Study Area.

Under Alternative 1, seagrasses in the Key West Range Complex could potentially be exposed to underwater and surface explosions from only six charges. The overlap of seagrass with this stressor is as described in Section 3.7.3.1.1 (Impacts from Explosives) and does not include ESA-listed Johnson's seagrass, see Figure 3.7-2. The impact footprint of the planned underwater explosions on bottom habitats in the Key West Range Complex is 0.00019 nm^2, see Table 3.3-5. This is a small area relative to the gross estimation of 130 nm^2 of seagrass in the range complex. Underwater explosions conducted for training activities are not expected to cause any risk to seagrass because: (1) the impact area of underwater explosions is very small relative to seagrass distribution, (2) the low number of charges reduces the potential for impacts, and (3) disturbance would be temporary. Underwater and surface explosions are not anticipated to affect any primary constituent elements or areas that meet critical habitat criteria for Johnson's seagrass.

In comparison to the No Action Alternative, the increase in activities presented in Alternative 1 may increase the risk of *Sargassum* and attached macroalgae to exposure from surface explosions. It should be noted that the majority of the difference is due to the increase in medium-caliber projectiles, which are the smallest type of explosive described in Section 3.0.5.3.1.2 (Explosives). The differences in overlap with *Sargassum* and seafloor macroalgae and the potential impacts of surface explosions on them during training activities would not be discernible from those described in Section 3.7.3.1.1.1 (No Action Alternative). For the same reasons as stated in Section 3.7.3.1.1.1 (No Action Alternative) for *Sargassum* and attached macroalgae, surface explosions are not expected to result in detectable changes to their growth, survival, or propagation, and are not expected to result in population-level impacts.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 1:

- *will have no effect on ESA-listed Johnson's seagrass and*
- *will have no effect on Johnson's seagrass critical habitat.*

Testing Activities

Under Alternative 1, underwater and surface explosions conducted in the Study Area would increase by three-fold compared to the No Action Alternative (Section 3.0.5.3.1.2, Explosives). As under the No Action Alternative, testing activities would continue to occur in the Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems, specifically within the VACAPES Range Complex; JAX Range Complex; Panama City OPAREA; and Naval Surface Warfare Center, Panama City Division Testing Range. The majority of the explosions would occur in VACAPES and JAX

Range Complexes. Under Alternative 1, activities would be introduced in the Key West Range Complex in the Gulf of Mexico Large Marine Ecosystem.

The general conditions described for testing activities, the overlap with *Sargassum* and attached macroalgae, and the potential impacts on *Sargassum* and attached macroalgae from exposure to surface explosions are as described in Section 3.7.3.1.1.1 (No Action Alternative).

Seagrasses are absent from all of the Alternative 1 testing locations for underwater and surface explosions based on the general practice of excluding explosions from areas where seagrasses predominantly grow (e.g., bays, rivers, and estuaries) (Section 3.7.2.8, Seagrasses, Cordgrasses, and Mangroves [Phylum Magnoliophyta]), and relevant marine vegetation maps (National Coastal Data Development Center and National Oceanic and Atmospheric Administration 2012; North Carolina Department of Environmental and Natural Resources 2012). For example, underwater explosions introduced under Alternative 1 from ship shock activities in the VACAPES or JAX Range Complexes only occur in waters that exceed 3,000 m (9,842.5 ft.) in depth which is beyond the depth limit of seagrasses (26.5 m [86.9 ft.]).

In comparison to the No Action Alternative, the three-fold increase in activities presented in Alternative 1 may increase the risk of *Sargassum* and attached macroalgae from exposure to underwater and surface explosions. It should be noted that the majority of the difference is due to the increase in medium-caliber projectiles, which are the smallest type of explosive described in Section 3.0.5.3.1.2 (Explosives). The differences in *Sargassum* and attached macroalgae overlap, and potential impacts of surface explosions on *Sargassum* and attached macroalgae during training activities would not be discernible from those described in Section 3.7.3.1.1.1 (No Action Alternative). Surface explosions are not expected to result in detectable changes to *Sargassum* or attached macroalgae growth, survival, or propagation, and are not expected to result in population-level impacts; and there are no potential impacts to seagrass. Similarly, underwater and surface explosions are not anticipated to affect any primary constituent elements or areas that meet critical habitat criteria for Johnson's seagrass.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 1:

- *will have no effect on ESA-listed Johnson's seagrass and*
- *will have no effect on Johnson's seagrass critical habitat.*

3.7.3.1.1.3 Alternative 2 (Preferred Alternative)

Training Activities

The number and location of training activities under Alternative 2 are identical to training activities under Alternative 1. Therefore, impacts and comparisons to the No Action Alternative will also be identical as described in Section 3.7.3.1.1.2 (Alternative 1).

Testing Activities

Under Alternative 2, underwater and surface explosion use in the Study Area would increase by four-fold compared to the No Action Alternative but this is only a 31 percent increase compared to Alternative 1 (Section 3.0.5.3.1.2, Explosives). The locations of testing activities under Alternative 2 are identical to testing activities under Alternative 1.

The four-fold increase in surface explosions over the No Action Alternative and 31 percent increase in explosions over Alternative 1 may increase the risk of *Sargassum* and attached macroalgae exposure to surface explosions under Alternative 2. However, the differences in *Sargassum* and attached macroalgae overlap, and potential impacts of surface explosions on *Sargassum* and attached macroalgae during testing activities would not be discernible from those described in Section 3.7.3.1.1.1 (No Action Alternative).

For the same reasons as stated in Section 3.7.3.1.1.2 (Alternative 1), surface explosions are not expected to result in detectable changes to *Sargassum* or attached macroalgae growth, survival, or propagation, and are not expected to result in population-level impacts; and there are no potential impacts to seagrass. Similarly, underwater and surface explosions are not anticipated to affect any primary constituent elements or areas that meet critical habitat criteria for Johnson's seagrass.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 2:

- *will have no effect on ESA-listed Johnson's seagrass and*
- *will have no effect on Johnson's seagrass critical habitat.*

3.7.3.1.1.4 Substressor Impact on Marine Vegetation as Essential Fish Habitat (Preferred Alternative)

Pursuant to the Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of explosives during training and testing activities may have an adverse effect on Essential Fish Habitat by reducing the quality and quantity of marine vegetation that constitutes Essential Fish Habitat or Habitat Areas of Particular Concern. The AFTT Essential Fish Habitat Assessment report states that the impact on attached macroalgae is determined to be minimal and temporary to short-term throughout the Study Area (U.S. Department of the Navy 2013). The impact on floating macroalgae is determined to be minimal and short-term throughout the Study Area (U.S. Department of the Navy 2013). Given the available information, the impact on submerged rooted vegetation beds is determined to be minimal and long-term (U.S. Department of the Navy 2013).

3.7.3.2 Physical Disturbance and Strike Stressors

This section analyzes the potential impacts of the various types of physical disturbance and strike stressors used by the Navy during training and testing activities within the Study Area. For a list of Navy activities that involve this stressor refer to Section 3.0.5.3.3 (Physical Disturbance and Strike Stressors). The physical disturbance and strike stressors that may impact marine vegetation include (1) vessels and in-water devices, (2) military expended materials, and (3) seafloor devices.

The evaluation of impacts to marine vegetation from physical disturbance or strike stressors focuses on proposed activities that may cause vegetation to be damaged by an object moving through the water (e.g., vessels and in-water devices), dropped into the water (e.g., military expended materials), or devices deployed on the seafloor (e.g., mine shapes and anchors). Not all activities are proposed throughout the Study Area. Wherever appropriate, specific geographic areas (i.e., large marine ecosystems and OPAREAs) of potential impact are identified (Section 3.0.5.3.3, Physical Disturbance and Strike Stressors).

Single-celled algae may overlap with physical disturbance or strike stressors, but the impact would be minimal relative to their total population level; therefore, they will not be discussed further. Seagrasses and macroalgae on the seafloor and *Sargassum* on the sea surface are the only types of marine vegetation that occur in locations where physical disturbance or strike stressors may be encountered. Therefore, only seagrasses, macroalgae, and *Sargassum* are analyzed further for potential impacts of physical disturbance or strike stressors. Since the occurrence of *Sargassum* is an indicator of marine mammal and sea turtle presence, some mitigation measures designed to reduce impacts on these resources may indirectly reduce impacts on *Sargassum* (see Section 5.3.2.2, Physical Strike and Disturbance).

3.7.3.2.1 Impacts from Vessels and In-Water Devices

The majority of the training and testing activities under all the alternatives involves vessels, and some activities involve the use of in-water devices. For a discussion of the types of activities that use vessels and in-water devices, where they are used, and how many activities would occur under each alternative (see Section 3.0.5.3.3 Physical Disturbance and Strike Stressors). For a list of Navy activities that involve vessel movement and in-water devices, refer to Sections 3.0.5.3.3.1 (Vessels) and 3.0.5.3.3.2 (In-Water Devices), respectively. In-water devices such as unmanned underwater vehicles are typically propeller driven and operate within the water column and would not intersect with marine vegetation and, therefore, will not be discussed further. Towed in-water devices are operated either on the sea surface or below it.

Physical disturbances and strikes by vessels, in-water devices, and towed in-water devices on seafloor vegetation such as seagrass and attached macroalgae are not considered since these types of occurrences would involve contact with the seafloor. Interaction of vessels, in-water devices, and towed in-water devices with the seafloor is avoided due to the potential for damage to equipment. Amphibious vehicles are an exception to this given that they are designed to come into contact with the seafloor in the surf zone (area of wave action). However, attached macroalgae and seagrass do not overlap with amphibious combat vehicle activities based on relevant literature and resource maps (Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute 2012; North Carolina Department of Environmental and Natural Resources 2012). Macroalgae floating in the area may be disturbed by amphibious combat vehicle activities but the impact would not be detectable given the low number of activities (see Table 2.8-1) and will not be considered further.

The only type of marine vegetation that may potentially be disturbed by vessels and in-water devices is *Sargassum*. *Sargassum* distribution is difficult to predict (Gower and King 2008; South Atlantic Fishery Management Council 2002) and it may overlap with any of the locations where vessels and in-water devices are used. In the Study Area, the relative coverage of *Sargassum* is very low ranging from less than 1 percent to 5 percent of the sea surface; see Section 3.7.2.6 (Diatoms and Brown Algae [Phylum Ochrophyta]) for details. *Sargassum* may be impacted by vessels and in-water devices, although *Sargassum* is resilient to natural conditions caused by wind, wave action, and severe weather that may break apart pieces of the mat or cause the mats to sink. In the unlikely situation that a *Sargassum* mat is broken by a vessel or in-water device, the broken pieces may develop into new *Sargassum* mats because *Sargassum* reproduces by vegetative fragmentation (new plants develop from pieces of the parent plant) (South Atlantic Fishery Management Council 1998). Impacts to *Sargassum* from vessels and in-water devices may potentially collapse the pneumatocysts that keep the mats floating at the surface. Evidence suggests that *Sargassum* will remain floating even when up to 80 percent of the pneumatocysts are removed (Zaitsev 1971). Even if a vessel or in-water device strike results in the collapse of most of a *Sargassum* mat's pneumatocysts, it may not cause it to sink.

Standard operating procedures involving towed devices reduce the devices' impact on *Sargassum*. Prior to deploying a towed device, there is a standard operating procedure to search the intended path of the device for any floating debris (i.e., driftwood) or other potential obstructions (i.e., *Sargassum* concentrations and animals), since they have the potential to cause damage to the device. This practice reduces the potential for towed devices to strike *Sargassum*. Vessels and in-water devices could cause injury to the organisms that inhabit *Sargassum*. See Sections 3.4 (Marine Mammals), 3.5 (Sea Turtles and Other Marine Reptiles), 3.8 (Marine Invertebrates), and 3.9 (Fish) for the assessment of impacts from vessels and in-water devices on these resources.

3.7.3.2.1.1 No Action Alternative, Alternative 1, and Alternative 2 (Preferred Alternative)

Section 3.0.5.3.3.1 (Vessels) and Section 3.0.5.3.3.2 (In-Water Devices) provide estimates of relative vessel use and location for each of the alternatives. These estimates are based on the number of activities predicted for each alternative. While these estimates provide a prediction of use, actual Navy vessel usage is dependent upon military training requirements, deployment schedules, annual budgets, and other unpredictable factors. Training and testing concentrations are most dependent upon locations of Navy shore installations and established training and testing areas. Even with the introduction of the Undersea Warfare Training Range, these areas have not appreciably changed in the last decade and are not expected to change in the foreseeable future. Under Alternatives 1 and 2, the Study Area would be expanded from the No Action Alternative and the number of events may increase, but the concentration of vessel and in-water device use and the manner in which the Navy trains and tests would remain consistent with the range of variability observed over the last decade. This is partly because multiple activities occur from the same vessel platform. Therefore, the increased number of activities estimated for Alternatives 1 and 2 is not expected to result in an increase in vessel use or transit. 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 strikes are expected to occur is likely to remain consistent with the previous decade or be reduced because of the implementation of mitigation measures as outlined in Chapter 5, Standard Operating Procedures, Mitigation Measures and Monitoring. The difference in activities from the No Action Alternative to Alternative 1 and Alternative 2, shown in Table 3.0-36, is not likely to change the probability of a vessel strike in any meaningful way.

<u>Training Activities</u>

As indicated in Sections 3.0.5.3.3.1 (Vessels) and 3.0.5.3.3.2 (In-Water Devices), the majority of the training activities under all alternatives involve vessels, and a few of the activities involve the use of in-water devices. See Section 3.0.5.3.3.1 (Vessels) for a representative list of Navy vessel sizes and speeds and the number and location of activities including vessels and Section 3.0.5.3.3.2 (In-Water Devices) for the types, sizes, and speeds of Navy in-water devices used in the Study Area and the number and location of activities including in-water devices. These activities could be widely dispersed throughout the Study Area, but would be more concentrated near naval ports, piers, and range areas. Navy training vessel traffic would be concentrated near Naval Station Norfolk in Norfolk, Virginia, in the Northeast U.S. Continental Shelf Large Marine Ecosystem and Naval Station Mayport in Jacksonville, Florida in the Southeast U.S. Continental Shelf Large Marine Ecosystem. There is no seasonal differentiation in Navy vessel use. 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.

As indicated in Section 3.0.5.3.3.2 (In-Water Devices), training activities involving in-water devices occur in the Gulf of Mexico, Northeast U.S. Continental Shelf, and Southeast U.S. Continental Shelf Large Marine Ecosystems, as well as the Gulf Stream Open Ocean Area, specifically within the Northeast, VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes. Use of in-water devices is concentrated within the VACAPES Range Complex. The number of in-water device activities increases by approximately 80 percent under Alternative 1 and Alternative 2 compared to the No Action Alternative.

There is no overlap of vessels or in-water devices with designated critical habitat for Johnson's seagrass. In addition to primary constituent elements, Johnson's seagrass critical habitat must meet at least one of five criteria (see Section 3.7.2.2.1, Status and Management). The Study Area does not meet any of the additional criteria; therefore, neither vessels nor in-water devices will affect Johnson's seagrass critical habitat.

Vessel and in-water devices used in training activities would not cause a detectable impact on *Sargassum* because: (1) the relative coverage of *Sargassum* in the Study Area is low, (2) new growth may result from *Sargassum* exposure to vessels and in-water devices, and (3) standard operating procedures reduce the potential for impacts caused by in-water devices. Based on these factors, potential impacts to *Sargassum* from vessels and in-water devices are not expected to result in detectable changes to its growth, survival, or propagation, and are not expected to result in population-level impacts.

Pursuant to the ESA, the use of vessels and in-water devices during training activities as described under the No Action Alternative, Alternative 1, and Alternative 2:

- *will have no effect on ESA-listed Johnson's seagrass and*
- *will have no effect on Johnson's seagrass critical habitat.*

Testing Activities

As indicated in Sections 3.0.5.3.3.1 (Vessels) and 3.0.5.3.3.2 (In-Water Devices), Navy testing vessel traffic would be concentrated near Naval Station Norfolk in Norfolk, Virginia, in the Northeast U.S. Continental Shelf Large Marine Ecosystem and Naval Station Mayport in Jacksonville, Florida in the Southeast U.S. Continental Shelf Large Marine Ecosystem.

As indicated in Section 3.0.5.3.3.2 (In-Water Devices), testing activities involving in-water devices occur in the Gulf of Mexico and Northeast U.S. Continental Shelf Large Marine Ecosystems as well as the Gulf Stream Open Ocean Area, specifically within the Northeast and VACAPES Range Complexes and Naval Surface Warfare Center, Panama City Division Testing Range. The differences in the number of in-water device activities between alternatives increases by approximately twofold under Alternative 1 and Alternative 2 compared to the No Action Alternative.

Propulsion testing activities, also referred to as high speed vessel trials, occur infrequently but pose a higher strike risk because of the high-speeds at which the vessels need to transit to complete the testing activity. These activities would most often occur in the Gulf of Mexico Large Marine Ecosystem in the GOMEX Range Complex, but may also occur in the Northeast U.S. Continental Shelf Large Marine Ecosystem in the Northeast Range Complexes, the Gulf Stream Open Ocean Area, and the North Atlantic Gyre Open Ocean Area in the VACAPES and JAX Range Complexes. However, there are just a few of these activities proposed per year so the increased risk is nominal compared to all vessel use in the Proposed Action. While there are just a few of these activities proposed per year, the high speed nature of the test may increase the likelihood of disturbance to *Sargassum*.

In-water device use would be concentrated in the Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems, specifically in the Northeast Range Complexes; VACAPES Range Complex; and Naval Surface Warfare Center, Panama City Division Testing Range (see Section 3.0.5.3.3.2, In-Water Devices).

There is no overlap of vessels or in-water devices with designated critical habitat for Johnson's seagrass. In addition to primary constituent elements, Johnson's seagrass critical habitat must meet at least one of five criteria (Section 3.7.2.2.1, Status and Management). The Study Area does not meet any of the additional criteria; therefore, neither vessels nor in-water devices will affect Johnson's seagrass critical habitat.

Vessel and in-water devices used in testing activities would not cause a detectable impact on *Sargassum* because: (1) the relative coverage of *Sargassum* in the Study Area is low, (2) new growth may result from *Sargassum* exposure to vessels and in-water devices, and (3) standard operating procedures reduce the potential for impacts caused by in-water devices. Based on these factors, potential impacts to *Sargassum* from vessels and in-water devices are not expected to result in detectable changes to its growth, survival, or propagation, and are not expected to result in population-level impacts.

Pursuant to the ESA, the use of vessels and in-water devices during testing activities as described under the No Action Alternative, Alternative 1, and Alternative 2:

- *will have no effect on ESA-listed Johnson's seagrass; and*
- *will have no effect on Johnson's seagrass critical habitat.*

3.7.3.2.1.2 Substressor Impact on Marine Vegetation as Essential Fish Habitat (Preferred Alternative)

Pursuant to the Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of vessels and in-water devices during training and testing activities would have no impact on attached macroalgae or submerged rooted vegetation that constitutes Essential Fish Habitat or Habitat Areas of Particular Concern. The use of vessels and in-water devices during training and testing activities may have an adverse effect by reducing the quality and quantity of floating macroalgae that constitutes Essential Fish Habitat or Habitat Areas of Particular Concern. The AFTT Essential Fish Habitat Assessment report states that any impacts to *Sargassum* incurred by vessel movements and in-water devices would be minimal and short-term in duration (U.S. Department of the Navy 2013).

3.7.3.2.2 Impacts from Military Expended Materials

This section analyzes the strike potential to marine vegetation of the following categories of military expended materials: (1) non-explosive practice munitions, (2) fragments from high-explosive munitions, and (3) expended materials other than munitions, such as sonobuoys, vessel hulks, and expendable targets. For a discussion of the types of activities that use military expended materials, where they are used, and how many activities would occur under each Alternative, see Section 3.0.5.3.3.3 (Military Expended Material Strikes).

In areas where marine vegetation and locations for military expended materials overlap, vegetation that occurs on the surface of the water, in the water column, or rooted in the seafloor may be impacted. Attached macroalgae and single-celled algae may overlap with military expended material locations. If these vegetation types are in the immediate vicinity of military expended materials, only a small number of individuals are likely to be impacted relative to their total population level (see Section 3.0.5.3.3.3, Military Expended Material Strikes). The low number of military expended materials relative to the total amount of attached macroalgae and single-celled algae in the Study Area also decreases the potential for impacts to these vegetation types.

Some types of attached macroalgae such as kelp only occur in a very small part of the Study Area in the Northeast U.S. Continental Shelf Large Marine Ecosystem, specifically in the Northeast Range Complexes, where less than 2 percent of the activities that involve military expended materials are conducted, greatly limiting kelp exposure to this stressor (Section 3.7.2.6, Diatoms and Brown Algae [Phylum Ochrophyta] and Section 3.0.5.3.3.3, Military Expended Material Strikes). Based on these factors, the impact on these types of marine vegetation would not be detectable and they will not be discussed further. Seagrasses on the seafloor and *Sargassum* on the sea surface are the types of marine vegetation that may potentially be impacted by military expended materials. Neither the ESA-listed species Johnson's seagrass, nor its critical habitat, overlap with the Study Area; however, an analysis of potential impacts is included due to its proximity to training and testing activity areas.

The potential for impacts to marine vegetation from military expended materials would depend on the presence and amount of vegetation, and the size and number of military expended materials. *Sargassum* distribution is difficult to predict (Gower and King 2008; South Atlantic Fishery Management Council 2002) and it may intersect with any of the locations where military materials are expended on the sea surface. Most deposition of military expended materials occurs within the confines of established training and testing areas. These areas are largely away from the coastline on the continental shelf and slope.

In the Study Area, the relative coverage of *Sargassum* is very low, ranging from less than 1 percent to 5 percent of the sea surface. Section 3.7.2.6, Diatoms and Brown Algae (Phylum Ochrophyta) contains additional detail. *Sargassum* may be impacted by military expended materials, although *Sargassum* is resilient to natural conditions caused by wind, wave action, and severe weather that may break apart pieces of the mat or cause the mats to sink. In the unlikely situation that a *Sargassum* mat is broken by military expended materials, the broken pieces may develop into new *Sargassum* mats because *Sargassum* reproduces by vegetative fragmentation (new plants develop from pieces of the parent plant) (South Atlantic Fishery Management Council 1998). Impacts to *Sargassum* from military expended materials may potentially collapse the pneumatocysts that keep the mats floating at the surface. Evidence suggests that *Sargassum* will remain floating even when up to 80 percent of the pneumatocysts are removed (Zaitsev 1971). Even if a military expended material's strike results in the collapse of most of a *Sargassum* mat's pneumatocysts, it may not cause it to sink. In addition, if enough military expended materials are deposited on *Sargassum*, the mats can potentially sink, but sinking occurs as a natural part of the aging process of *Sargassum* (Schoener and Rowe 1970). Strikes could cause injury to the organisms that inhabit *Sargassum.* See Sections 3.4 (Marine Mammals), 3.5 (Sea Turtles and Other Marine Reptiles), 3.8 (Marine Invertebrates), and 3.9 (Fish) for the assessment of military expended materials on these resources.

Military expended materials can potentially impact seagrass on the seafloor by disturbing, crushing, or shading which may interfere with photosynthesis. In the event that seagrass is not able to photosynthesize its ability to produce energy is compromised. However, the intersection of seagrasses and military expended materials is limited. The only area where military expended materials may overlap with seagrasses is in the Key West Range Complex based on relevant mapping data, see Figure 3.7-2 (Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute 2012). Otherwise, seagrasses generally grow in waters that are sheltered from wave action such as estuaries, lagoons and bays (Phillips and Meñez 1988). Locations for the majority of Navy training and testing activities where military materials are expended do not provide this type of habitat. The potential for detectable impacts on seagrasses from expended materials would be low given the small size (e.g., countermeasures) of the majority of the materials, low velocity at deployment (e.g., countermeasures), and the decrease in speed as they hit the sea surface. Falling materials could cause bottom sediments to be suspended. Resuspension of the sediment could impact water quality and decrease light exposure but since it would be short-term (hours), stressors from military expended materials would not likely impact the general health of seagrasses.

The following are descriptions of the types of military expended materials that can potentially impact *Sargassum* and seagrass. *Sargassum* may potentially overlap with military expended materials anywhere in the Study Area. The Key West Range Complex is the only location where these materials may overlap with seagrasses. Tables 3.3-9 through 3.3-13 present the number and location of activities that involve military expended materials that are proposed for use during training and testing activities by location and alternative.

Small-, Medium-, and Large-Caliber Projectiles. Small-, medium-, and large-caliber non-explosive practice munitions, or fragments from high-explosive projectiles expended during training and testing activities rapidly sink to the seafloor. The majority of these projectiles would be expended in the Northeast U.S. Continental Shelf Large Marine Ecosystem in the VACAPES Range Complex. Due to the small size of projectiles and their casings, damage to marine vegetation is unlikely. Large-caliber projectiles are primarily used offshore (at depths greater than 26 m [86.9 ft.]) while small- and medium-caliber projectiles may be expended in both offshore and coastal areas (at depths less than 26 m [86.9 ft.]). *Sargassum* could occur where these materials are expended but seagrasses generally do not because these activities do not normally occur in water that is shallow enough for seagrass to grow (26 m [86.9 ft.]).

Bombs, Missiles, and Rockets. Bombs, missiles, and rockets, or their fragments (if high-explosive) are expended offshore (depths greater than 26 m [86.9 ft.]) during training and testing activities and rapidly sink to the seafloor. *Sargassum* could occur where these materials are expended but seagrass generally does not because of water depth limitations for activities that expend these materials.

Parachutes. Parachutes of varying sizes are used during training and testing activities. For a discussion of the types of activities that use parachutes, physical characteristics of these expended materials, where they are used, and how many activities will occur under each alternative, see Section 3.0.5.3.4.2 (Parachutes). Seagrass may overlap with the use of some types of parachutes in the Gulf of Mexico Large Marine Ecosystem in the Key West Range Complex. *Sargassum* could occur in any of the locations that these materials are expended.

Targets. Many training and testing activities require the use of targets. Once targets are hit by munitions they could be broken into fragments. Target fragments vary in size and type, but most fragments are expected to sink. Pieces of targets that are designed to float are recovered when possible. *Sargassum* and seagrass could occur where these materials are expended.

Vessel Hulk. Vessel hulks are notable items of military expended materials due to their size. They are expended at sea during sinking exercises. Sinking exercises involve the use of a target (vessel hulk) against which live high-explosive or non-explosive munitions are fired; these exercises are conducted in a manner that results in the sinking of the target. Sinking exercises would only be conducted in designated areas with depths greater than 3,000 m (9,842 ft.) (see Section 3.0.3.1.4, Northeast U.S. Continental Shelf Large Marine Ecosystem). *Sargassum* could occur where these materials are expended but seagrass could not.

Countermeasures. Defensive countermeasures such as chaff and flares are used to protect against missile and torpedo attack. Chaff is made of aluminum-coated glass fibers and flares are pyrotechnic devices. Chaff, chaff canisters, and flare end caps are expended materials. Chaff and flares are dispensed from aircraft or fired from ships. Seagrass may overlap with chaff and flares expended in the Gulf of Mexico Large Marine Ecosystem in the Key West Range Complex. *Sargassum* could occur in any of the locations that these materials are expended.

3.7.3.2.2.1 No Action Alternative

Training Activities

Section 3.0.5.3.3.3 (Military Expended Material Strikes) contains information regarding the number and location of military expended materials, most of which are small- and medium-caliber projectiles. The number and footprint of military expended materials are detailed in Table 3.3-9. As indicated in Section 3.0.5.3.3.3 (Military Expended Material Strikes), under the No Action Alternative, the areas with the greatest numbers of expended materials are expected to be the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems and the Gulf Stream Open Ocean Area—specifically within the Northeast, VACAPES, Navy Cherry Point, JAX, Key West, and GOMEX Range Complexes, and in the Other AFTT Areas while vessels are in transit. Activities using military expended materials are concentrated within the VACAPES Range Complex. See Section 3.0.5.3.3.3 (Military Expended Material Strikes) for information regarding the number of military expended materials (e.g., bombs, projectiles, missiles, rockets, and vessel hulks) that are expended under the No Action Alternative.

Sargassum distribution is patchy and difficult to predict but it may overlap with any of the training locations for the No Action Alternative. The total impact area of military expended materials under the No Action Alternative is 0.13 nm^2 (see Table 3.3-9). This impact area is small relative to the distribution of *Sargassum* (21,000 nm^2 to 130,000 nm^2) in the Study Area.

Based on relevant mapping data (Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute 2012), military expended materials may overlap with seagrass only in the Key West Range Complex, see Figure 3.7-2. Under the No Action Alternative, only medium-caliber projectiles and items associated with chaff and flares are expended in the Key West Range Complex, although activities expending these items do not normally occur in water that is shallow enough for seagrass to grow (26 m [85.3 ft.]). The total impact area of military expended materials in the Key West Range Complex is less than 0.001 nm^2 (see Table 3.3-9); this is a small area relative to the gross estimation of 130 nm^2 of seagrass in the range complex.

There is no overlap of military expended materials with designated critical habitat for Johnson's seagrass. Primary constituent elements may occur in locations that have not been designated as critical habitat but Johnson's seagrass critical habitat must meet at least one of five additional criteria; see Section 3.7.2.2.1, Status and Management. The Study Area does not meet any of the additional criteria; therefore, military expended materials will not affect Johnson's seagrass critical habitat.

Military expended materials associated with training activities are not expected to cause any risk to *Sargassum* or seagrass because: (1) the relative coverage of *Sargassum* in the Study Area is low, (2) new growth may result from *Sargassum* exposure to military expended materials, (3) the impact area of military expended materials is very small relative to *Sargassum* distribution, and (4) seagrass overlap with areas where the stressor occurs is very limited. Based on these factors, potential impacts to *Sargassum* and seagrass from military expended materials are not expected to result in detectable changes to their growth, survival, or propagation, and are not expected to result in population-level impacts.

Pursuant to the ESA, the use of military expended materials associated with training activities as described under the No Action Alternative:

- *will have no effect on ESA-listed Johnson's seagrass and*
- *will have no effect on Johnson's seagrass critical habitat.*

Testing Activities

Section 3.0.5.3.3.3 (Military Expended Material Strikes) contains information regarding the number and location of military expended materials, most of which are small- and medium-caliber projectiles. The number and footprint of military expended materials are detailed in Table 3.3-10. As indicated in Section 3.0.5.3.3.3 (Military Expended Material Strikes), under the No Action Alternative, the areas with the greatest numbers of expended materials are expected to be the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems and the Gulf Stream Open Ocean Area, specifically within the Naval Surface Warfare Center, Panama City Division Testing Range; the Northeast, VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes; and in the Other AFTT Areas while vessels are in transit. Activities using military expended materials are concentrated within the VACAPES Range Complex. See Section 3.0.5.3.3.3 (Military Expended Material Strikes) for information regarding the number of military expended materials (e.g., bombs, projectiles, missiles, rockets, and vessel hulks) that are expended under the No Action Alternative.

Sargassum distribution is patchy and difficult to predict but it may overlap with any of the testing locations for the No Action Alternative. The total impact area of military expended materials under the No Action Alternative is less than 0.02 nm^2 (see Table 3.3-10). This impact area is small relative to the distribution of *Sargassum* (21,000 nm^2 to 130,000 nm^2) in the Study Area. Seagrass does not overlap with military expended materials under the No Action Alternative.

There is no overlap of military expended materials with designated critical habitat for Johnson's seagrass. Primary constituent elements may occur in locations that have not been designated as critical habitat but Johnson's seagrass critical habitat must meet at least one of five additional criteria (see Section 3.7.2.2.1, Status and Management). The Study Area does not meet any of the additional criteria; therefore, military expended materials will not affect Johnson's seagrass critical habitat.

Military expended materials associated with testing activities are not expected to cause any risk to *Sargassum* or seagrass because: (1) the relative coverage of *Sargassum* in the Study Area is low, (2) new growth may result from *Sargassum* exposure to military expended materials, (3) the impact area of military expended materials is very small relative to *Sargassum* distribution, and (4) seagrass does not overlap with areas where the stressor occurs. Based on these factors, potential impacts to *Sargassum* from military expended materials are not expected to result in detectable changes to its growth, survival, or propagation, and are not expected to result in population-level impacts; and there are no potential impacts to seagrass.

Pursuant to the ESA, the use of military expended materials associated with testing activities as described under the No Action Alternative:

- *will have no effect on ESA-listed Johnson's seagrass and*
- *will have no effect on Johnson's seagrass critical habitat.*

3.7.3.2.2.2 Alternative 1

Training Activities

Section 3.0.5.3.3.3 (Military Expended Material Strikes) contains information regarding the number and location of military expended materials, most of which are small- and medium-caliber projectiles. The number and footprint of military expended materials are detailed in Table 3.3-11. As indicated in Section 3.0.5.3.3.3 (Military Expended Material Strikes), under Alternative 1, the total number of military expended materials is more than twice the number expended in the No Action Alternative. The types of activities and military expended materials occurring in Alternative 1 would be the same as those in the No Action Alternative. Furthermore, the activities would occur in the same geographic locations. Activities using military expended materials are concentrated within the VACAPES, Navy Cherry Point, and JAX Range Complexes. See Section 3.0.5.3.3.3 (Military Expended Material Strikes) for information regarding the number of military expended materials (e.g., bombs, projectiles, missiles, rockets, and vessel hulks) that are expended under Alternative 1.

The potential impacts on *Sargassum* and seagrass from military expended materials is as described in Section 3.7.3.2.2 (Impacts from Military Expended Materials). *Sargassum* distribution may overlap with any of the training locations for the No Action Alternative. The total impact area of military expended materials under Alternative 1 is 0.07 nm^2 (see Table 3.3-11). This impact area is small relative to the distribution of *Sargassum* (21,000 nm^2 to 130,000 nm^2) in the Study Area. Based on relevant mapping data (Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute 2012), military expended materials may overlap with seagrass only in the Key West Range Complex, see Figure 3.7-2. Under Alternative 1, in addition to the types of items expended under the No Action Alternative, large-caliber projectiles, anchor blocks, and parachutes are also expended in the Key West Range Complex, although activities expending these materials do not normally occur in water that is shallow enough for seagrass to grow (26 m [85.3 ft.]). The total impact area of these materials in the Key West Range Complex is less than 0.001 nm^2 (see Table 3.3-11); this is a small area relative to the gross estimation of 130 nm^2 of seagrass in the range complex.

In comparison to the No Action Alternative, the increase in the number of activities presented in Alternative 1 may increase the risk of *Sargassum* and seagrass of exposure to military expended materials. However, the differences in species overlap and potential impacts of surface explosions on *Sargassum* and seagrass during training activities would not be discernible from those described in Section 3.7.3.2.2.1 (No Action Alternative). For the same reasons as stated in Section 3.7.3.2.2.1 (No Action Alternative), the use of military expended materials are not expected to result in detectable changes to *Sargassum* or seagrass growth, survival, or propagation, and are not expected to result in population-level impacts. Similarly, military expended materials are not anticipated to affect any primary constituent elements or areas that meet critical habitat criteria for Johnson's seagrass.

Pursuant to the ESA, the use of military expended materials associated with training activities as described under Alternative 1:

- *will have no effect on ESA-listed Johnson's seagrass and*
- *will have no effect on Johnson's seagrass critical habitat.*

Testing Activities

Section 3.0.5.3.3.3 (Military Expended Material Strikes) contains information regarding the number and location of military expended materials, most of which are small- and medium-caliber projectiles. The number and footprint of military expended materials are detailed in Table 3.3-12. As indicated in Section 3.0.5.3.3.3 (Military Expended Material Strikes), under Alternative 1, the total number of military expended materials is nearly four-times the number expended in the No Action Alternative. The types of activities and military expended materials occurring in Alternative 1 would be the same as those in the No Action Alternative. Furthermore, the activities would occur in the same geographic locations. Activities using military expended materials are concentrated within the VACAPES Range Complex. Military expended materials would typically be of the same type listed under the No Action Alternative. See Section 3.0.5.3.3.3 (Military Expended Material Strikes) for information regarding the number of military expended materials (e.g., bombs, projectiles, missiles, rockets, and vessel hulks) that are expended under Alternative 1.

The potential impacts on *Sargassum* and seagrass from military expended materials are as described in Section 3.7.3.2.2 (Impacts from Military Expended Materials). *Sargassum* distribution may overlap with any of the testing locations for the No Action Alternative. The total impact area of military expended materials under Alternative 1 is 0.03 nm^2 (Table 3.3-12). This impact area is small relative to the distribution of *Sargassum* (21,000 nm^2 to 130,000 nm^2) in the Study Area. Under Alternative 1, seagrass may potentially overlap with military expended materials. Based on relevant mapping data (Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute 2012), military expended materials may overlap with seagrass only in the Key West Range Complex, see Figure 3.7-2. Under Alternative 1, medium- and large-caliber projectiles, missiles, sonobuoys, parachutes, and aircraft stores are expended in the Key West Range Complex, although activities expending these materials do not normally occur in water that is shallow enough for seagrass to grow (26 m [85.3 ft.]). The total impact area of these materials in the Key West Range Complex is less than 0.002 nm^2; this is a small area relative to the gross estimation of 130 nm^2 of seagrass in the range complex.

In comparison to the No Action Alternative, the increase in activities presented in Alternative 1 may increase the risk of *Sargassum* and seagrass exposure to military expended materials. However, the differences in species overlap and potential impacts of surface explosions on *Sargassum* and seagrass during testing activities would not be discernible from those described in Section 3.7.3.2.2.1 (No Action Alternative). Military expended materials used for testing activities are not expected to cause any risk to seagrass because the overlap with areas where the stressor occurs is very limited. For the same reasons as stated in Section 3.7.3.2.2.2 (Alternative 1) for *Sargassum*, and here for seagrass, the use of military expended materials is not expected to result in detectable changes to *Sargassum* or seagrass growth, survival, or propagation, and is not expected to result in population-level impacts. Similarly, military expended materials are not anticipated to affect any primary constituent elements or areas that meet critical habitat criteria for Johnson's seagrass.

Pursuant to the ESA, the use of military expended materials associated with testing activities as described under Alternative 1:

- *will have no effect on ESA-listed Johnson's seagrass and*
- *will have no effect on Johnson's seagrass critical habitat.*

3.7.3.2.2.3 Alternative 2 (Preferred Alternative)

Training Activities

The number and location of training activities under Alternative 2 are identical to training activities under Alternative 1. Therefore, impacts and comparisons to the No Action Alternative will be identical as described in Section 3.7.3.2.2.2 (Alternative 1).

Testing Activities

Section 3.0.5.3.3.3 (Military Expended Material Strikes) contains information regarding the number and location of military expended materials, most of which are small and medium caliber projectiles. The number and footprint of military expended materials are detailed in Table 3.3-13. As indicated in Section 3.0.5.3.3.3 (Military Expended Material Strikes), under Alternative 2, the total amount of military expended materials is more than four times the amount expended in the No Action Alternative, but only increases by 5 percent as compared to Alternative 1. The types of activities and military expended materials occurring in Alternative 1 would be the same as those in the No Action Alternative. Furthermore, the activities would occur in the same geographic locations. Activities using military expended materials are concentrated within the VACAPES Range Complex. Military expended materials would typically be of the same type listed under the No Action Alternative. See Section 3.0.5.3.3.3 (Military Expended Material Strikes) for information regarding the number of military expended materials (e.g., bombs, projectiles, missiles, rockets, and vessel hulks) that are expended under Alternative 2.

The potential impacts on *Sargassum* and seagrass from military expended materials are as described in Section 3.7.3.2.2 (Impacts from Military Expended Materials). *Sargassum* distribution may overlap with any of the testing locations for Alternative 2. The total impact area of military expended materials under Alternative 2 is 0.03 nm^2 (See Table 3.3-13). This impact area is small relative to the distribution of *Sargassum* (21,000 nm^2 to 130,000 nm^2) in the Study Area. Under Alternative 2, the total impact area of military expended materials in the Key West Range Complex is less than 0.002 nm^2; this is a small area relative to the gross estimation of 130 nm^2 of seagrass in the range complex (see Table 3.3-13).

In comparison to the No Action Alternative, the overall increase in activities presented in Alternative 2 may increase the risk of *Sargassum* and seagrass exposure to military expended materials. However, the differences in species overlap and potential impacts of surface explosions on *Sargassum* and seagrass during testing activities would not be discernible from those described in Section 3.7.3.2.2.1 (No Action Alternative). For the same reasons as stated in Section 3.7.3.2.2.1 (No Action Alternative) for *Sargassum* and seagrass, the use of military expended materials is not expected to result in detectable changes to *Sargassum* or seagrass growth, survival, or propagation, and is not expected to result in population-level impacts. Similarly, military expended materials are not anticipated to affect any primary constituent elements or areas that meet critical habitat criteria for Johnson's seagrass.

Pursuant to the ESA, the use of military expended materials associated with testing activities as described under Alternative 2:

- *will have no effect on ESA-listed Johnson's seagrass and*
- *will have no effect on Johnson's seagrass critical habitat.*

3.7.3.2.2.4 Substressor Impact on Marine Vegetation as Essential Fish Habitat (Preferred Alternative)

Pursuant to the Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, military expended materials associated with training and testing activities may have an adverse effect on Essential Fish Habitat by reducing the quality and quantity of marine vegetation that constitutes Essential Fish Habitat or Habitat Areas of Particular Concern. The AFTT Essential Fish Habitat Assessment states that any impacts to attached macroalgae or submerged rooted vegetation incurred by military expended materials would be minimal and long-term in duration; and any impacts to floating macroalgae would be minimal and short-term in duration (U.S. Department of the Navy 2013).

3.7.3.2.3 Impacts from Seafloor Devices

For a discussion of the types of activities that use seafloor devices, where they are used, and how many activities would occur under each alternative, see Section 3.0.5.3.3.4, Seafloor Devices. These include items that are placed on, dropped on, or moved along the seafloor such as anchors, anchor blocks, mine shapes, bottom-placed instruments, bottom-placed targets that are recovered (not expended), and bottom-crawling unmanned underwater vehicles.

Only marine vegetation that is attached to the seafloor such as attached macroalgae and seagrasses may be impacted by activities involving seafloor devices. If a seafloor device is placed directly on attached macroalgae, only a miniscule portion of the total population would likely be impacted given its wide distribution throughout the Study Area. The low number of seafloor devices relative to the amount of attached macroalgae in the Study Area also decreases its potential for impacts.

The use of anchors for precision anchoring training exercises involves the release of anchors in designated locations. These training activities typically occur within predetermined shallow water anchorage locations near ports with seafloors consisting of soft bottom substrate in areas that do not typically support seagrass. Mine shapes are used in a variety of activities and are normally deployed over soft sediments and are recovered within 7 to 30 days following completion of the training event. Neither of these activities takes place in areas where attached macroalgae or seagrasses are expected to occur, and they will not be discussed further.

Seafloor device operation, installation, or removal can potentially impact seagrass by physically removing vegetation (e.g., uprooting), crushing, temporarily increasing the turbidity (sediment suspended in the water) of waters nearby, or shading seagrass which may interfere with photosynthesis. In the event that seagrass is not able to photosynthesize, its ability to produce energy is compromised. However, the intersection of seagrasses and seafloor devices is limited and suspended sediments would settle in a few hours. The only seafloor devices that may potentially overlap with seagrass in the Study Area are bottom-crawling unmanned underwater vehicles used in the Northeast U.S. Continental Shelf Large Marine Ecosystem in the Naval Undersea Warfare Center Division, Newport Testing Range, Narragansett Bay; and in the Gulf of Mexico Large Marine Ecosystem in the Naval Surface Warfare Center, Panama City Division Testing Range, St. Andrew Bay.

In addition to the potential impacts of seafloor devices on seagrass, in soft substrates, crawlers may leave a track-line of depressed sediments 24 in. (62 cm) wide (the width of the device) in their wake. However, since these crawlers can operate in shallow water (less than 24.6 m), any disturbed sediments would be redistributed by wave and tidal action shortly (a few days) following the disturbance.

3.7.3.2.3.1 No Action Alternative

Training Activities

Section 3.0.5.3.3.4 (Seafloor Devices) contains information regarding the number of seafloor devices and locations where seafloor devices are used. As indicated in Section 3.0.5.3.3.4 (Seafloor Devices), under the No Action Alternative, seafloor devices occur in the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems as well as Gulf Stream Open Ocean Area, specifically within the VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes.

Under the No Action Alternative, training activities do not involve the operation of bottom-crawling unmanned underwater vehicles in areas where seagrasses occur; see Section 3.0.5.3.3.4 (Seafloor Devices). Therefore, seafloor devices are not expected to cause any risk to seagrass.

There is no overlap of seafloor devices with designated critical habitat for Johnson's seagrass. Primary constituent elements may occur in locations that have not been designated as critical habitat but Johnson's seagrass critical habitat must meet at least one of five additional criteria (see Section 3.7.2.2.1, Status and Management). The Study Area does not meet any of the additional criteria; therefore, seafloor devices will not affect Johnson's seagrass critical habitat.

Pursuant to the ESA, the use of seafloor devices during training activities as described under the No Action Alternative:

- *will have no effect on ESA-listed Johnson's seagrass and*
- *will have no effect on Johnson's seagrass critical habitat.*

Testing Activities

Section 3.0.5.3.3.4 (Seafloor Devices) contains information regarding the number of seafloor devices and locations where seafloor devices are used. As indicated in Section 3.0.5.3.3.4 (Seafloor Devices), under the No Action Alternative, seafloor devices are used in the Northeast and Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems as well as the Gulf Stream Open Ocean Area, specifically within the Northeast and VACAPES Range Complexes; Naval Undersea Warfare Center Division, Newport Testing Range; and Naval Surface Warfare Center, Panama City Division Testing Range.

Under the No Action Alternative, one testing activity that involves the operation of bottom-crawling unmanned underwater vehicles would occur in the Northeast U.S. Continental Shelf Large Marine Ecosystem in Narragansett Bay, and in the Gulf of Mexico Large Marine Ecosystem in the Naval Surface Warfare Center, Panama City Division Testing Range; see Section 3.0.5.3.3.4 (Seafloor Devices). The use of bottom-crawling unmanned underwater vehicles in Narragansett Bay may potentially overlap with seagrass. This activity may occur in St. Andrew Bay or another part of the Naval Surface Warfare Center, Panama City Division Testing Range, however, St. Andrew Bay is the only part of the testing range where seagrass occurs. Only one event is planned for unmanned underwater vehicle demonstrations at each location under the No Action Alternative. Seagrass is typically avoided during activities involving the use of bottom-crawling unmanned underwater vehicles but impacts on seagrass may occur, although the chances are small.

Seafloor devices used for testing activities are not expected to cause any risk to seagrass because: (1) seagrass overlap with the stressor is very limited, (2) seagrass is typically avoided, (3) the number of activities involving the stressor is low, and (4) disturbance from re-suspended sediment is temporary. Based on these factors, potential impacts to seagrass from seafloor devices are not expected to result in detectable changes to its growth, survival, or propagation, and are not expected to result in population-level impacts.

Pursuant to the ESA, the use of seafloor devices during testing activities as described under the No Action Alternative:

- *will have no effect on ESA-listed Johnson's seagrass and*
- *will have no effect on Johnson's seagrass critical habitat.*

3.7.3.2.3.2 Alternative 1

Training Activities

Section 3.0.5.3.3.4 (Seafloor Devices) contains information regarding the number of seafloor devices and locations where seafloor devices are used. As indicated in Section 3.0.5.3.3.4 (Seafloor Devices), under Alternative 1, the number of activities using seafloor devices is a 44 percent increase over the number of activities in the No Action Alternative. The activities using seafloor devices under Alternative 1 would occur in the same geographic locations as the No Action Alternative with the addition of one event that may occur in the Northeast Range Complexes.

As under the No Action Alternative, training activities under Alternative 1 do not involve the operation of bottom-crawling, unmanned, underwater vehicles in areas where seagrasses occur (see Section 3.0.5.3.3.4, Seafloor Devices). Therefore, seafloor devices are not expected to cause any risk to seagrass. Similarly, seafloor devices are not anticipated to affect any primary constituent elements or areas that meet critical habitat criteria for Johnson's seagrass.

Pursuant to the ESA, the use of seafloor devices during training activities as described under Alternative 1:

- *will have no effect on ESA-listed Johnson's seagrass and*
- *will have no effect on Johnson's seagrass critical habitat.*

Testing Activities

Section 3.0.5.3.3.4 (Seafloor Devices) contains information regarding the number of seafloor devices and locations where seafloor devices are used. As indicated in Section 3.0.5.3.3.4 (Seafloor Devices), under Alternative 1, the number of activities using seafloor devices is approximately two times higher than that of the No Action Alternative. The activities using seafloor devices under Alternative 1 would occur in the same geographic locations as those in Section 3.7.3.2.3.1 (No Action Alternative), in addition to new locations in the Northeast and Southeast U.S. Continental Shelf and Gulf of Mexico Large Marine Ecosystems, and the Gulf Stream Open Ocean Area. Specifically, under Alternative 1, seafloor devices would be introduced in the Naval Undersea Warfare Center Division, Newport Testing Range; Northeast, VACAPES, Navy Cherry Point, and JAX Range Complexes; South Florida Ocean Measurement Facility Testing Range; Naval Surface Warfare Center, Panama City Division Testing Range; and the Gulf of

Mexico. Seagrass does not occur in any of the new locations introduced under Alternative 1. Seagrass grows in the inland waters of the South Florida Ocean Measurement Facility Testing Range but the inland waters are not part of the Study Area. The only locations where seagrass and this stressor may potentially overlap are Narragansett Bay (part of Naval Undersea Warfare Center Division, Newport Testing Range) and St. Andrew Bay (part of the Naval Surface Warfare Center, Panama City Division Testing Range).

Under Alternative 1, the number of locations that use bottom-crawling unmanned underwater vehicles increases, but not in areas where there is potential overlap with seagrass. Activities in Narragansett Bay involving the use of bottom-crawling unmanned underwater vehicles are the same as under the No Action Alternative. In St. Andrew Bay, the number of activities that use bottom-crawling unmanned underwater vehicles increases from one (i.e., unmanned underwater vehicle demonstrations) under the No Action Alternative to two (i.e., unmanned underwater vehicle demonstrations and testing) under Alternative 1. Under Alternative 1, there would be 70 unmanned underwater vehicle testing events per year. Although the number of events increases under Alternative 1, the differences in species overlap and potential impacts of seafloor devices on seagrass during testing activities would not be discernible from those described in Section 3.7.3.2.3.1 (No Action Alternative). Therefore, the potential impacts from seafloor devices would be identical to those associated with the No Action Alternative.

It should be noted that bottom-crawling unmanned underwater vehicles would be operated at the South Florida Ocean Measurement Facility Testing Range, which is the closest testing range to Johnson's seagrass critical habitat (Section 3.7.2.2.2, Habitat and Geographic Range). However, there is no overlap of seafloor devices with designated critical habitat for Johnson's seagrass. Primary constituent elements of Johnson's seagrass critical habitat may occur in locations that have not been designated as critical habitat, but Johnson's seagrass critical habitat must meet at least one of five additional criteria (Section 3.7.2.2.1, Status and Management). The Study Area does not meet any of the additional criteria; therefore, seafloor devices will not affect Johnson's seagrass critical habitat.

Pursuant to the ESA, the use of seafloor devices during testing activities as described under Alternative 1:

- *will have no effect on ESA-listed Johnson's seagrass and*
- *will have no effect on Johnson's seagrass critical habitat.*

3.7.3.2.3.3 Alternative 2 (Preferred Alternative)

Training Activities

The number and location of training activities under Alternative 2 are identical to training activities under Alternative 1. Therefore, impacts and comparisons to the No Action Alternative will also be identical as described in Section 3.7.3.2.3.2 (Alternative 1).

Testing Activities

Section 3.0.5.3.3.4 (Seafloor Devices) contains information regarding the number of seafloor devices and locations where seafloor devices are used. As indicated in Section 3.0.5.3.3.4 (Seafloor Devices), under Alternative 2, the number of activities using seafloor devices is about twice that of those described in Section 3.7.3.2.3.1 (No Action Alternative). The activities using seafloor devices under Alternative 2 would occur in the same geographic locations as those under Alternative 1.

Under Alternative 2, the number of locations that use bottom-crawling unmanned underwater vehicles increases, but not in areas where there is potential overlap with seagrass. Activities in Narragansett Bay involving the use of bottom-crawling unmanned underwater vehicles do not change compared to the No Action Alternative. In St. Andrew Bay, the number of activities that use bottom-crawling unmanned underwater vehicles increases from one (i.e., unmanned underwater vehicle demonstrations) under the No Action Alternative to two (i.e., unmanned underwater vehicle demonstrations and testing) under Alternative 2. Under Alternative 2, there would be 88 unmanned underwater vehicle testing events per year. Although the number of events increases under Alternative 2, the differences in species overlap and potential impacts of seafloor devices on seagrass during testing activities would not be discernible from those described in Section 3.7.3.2.3.1 (No Action Alternative). Therefore, the potential impacts from seafloor devices would be identical to those associated with the No Action Alternative. As stated in Alternative 1, seafloor devices are not anticipated to affect any primary constituent elements or areas that meet critical habitat criteria for Johnson's seagrass.

Pursuant to the ESA, the use of seafloor devices during testing activities as described under Alternative 2:

- *will have no effect on ESA-listed Johnson's seagrass and*
- *will have no effect on Johnson's seagrass critical habitat.*

3.7.3.2.3.4 Substressor Impact on Marine Vegetation as Essential Fish Habitat (Preferred Alternative)

Pursuant to the Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of seafloor devices during training and testing activities would have no effect on floating macroalgae that constitutes Essential Fish Habitat or Habitat Areas of Particular Concern. The use of seafloor devices during training and testing activities may have an adverse effect on Essential Fish Habitat by reducing the quality or quantity of attached macroalgae and submerged rooted vegetation that constitutes Essential Fish Habitat or Habitat Areas of Particular Concern. The AFTT Essential Fish Habitat Assessment report states that any impacts to attached macroalgae or submerged rooted vegetation incurred by seafloor devices would be minimal and short-term in duration (U.S. Department of the Navy 2013).

3.7.3.3 Secondary Stressors

This section analyzes potential impacts to marine vegetation exposed to stressors indirectly through impacts on their habitat (i.e., sediment and water quality). Section 3.1 (Sediments and Water Quality) considered the impacts on marine sediments and water quality from explosives and explosion by-products, metals, chemicals other than explosives, and other materials (marine markers, flares, chaff, targets, and miscellaneous components of other materials). The analysis determined that neither state or federal standards or guidelines for sediments nor water quality would be violated by the No Action Alternative, Alternative 1, or Alternative 2. Given these conditions, the possibility of population-level impacts to marine vegetation (including *Sargassum* and seagrasses) is likely to be inconsequential and not detectable. Therefore, because these standards and guidelines are structured to protect human health and the environment, and the proposed activities do not violate them, there would be no indirect impacts anticipated on marine vegetation from the training and testing activities proposed by the No Action Alternative, Alternative 1, or Alternative 2.

3.7.3.3.1 No Action Alternative, Alternative 1, and Alternative 2 (Preferred Alternative) – Training

Pursuant to the ESA, secondary stressors resulting from training activities as described under the No Action Alternative, Alternative 1, and Alternative 2:

- *will have no effect on ESA-listed Johnson's seagrass and*
- *will have no effect on Johnson's seagrass critical habitat.*

3.7.3.3.2 No Action Alternative, Alternative 1, and Alternative 2 (Preferred Alternative) – Testing

Pursuant to the ESA, secondary stressors resulting from testing activities as described under the No Action Alternative, Alternative 1, and Alternative 2:

- *will have no effect on ESA-listed Johnson's seagrass and*
- *will have no effect on Johnson's seagrass critical habitat.*

3.7.4 SUMMARY OF POTENTIAL IMPACTS ON VEGETATION

3.7.4.1 Combined Impacts of All Stressors

Activities described in this EIS/OEIS that have potential impacts on marine vegetation are widely dispersed, and not all stressors would occur simultaneously in a given location. The stressors that have potential impacts on marine vegetation include acoustic (underwater and surface explosions) and physical disturbances or strikes (vessel and in-water devices, military expended materials, and seafloor devices). Unlike mobile organisms, vegetation cannot flee from stressors once exposed. *Sargassum* is the type of marine vegetation most likely to be exposed to multiple stressors in combination because it occurs in large expanses. Discrete areas of the Study Area (mainly within off-shore areas with depths greater than 26 m [85.3 ft.] in portions of range complexes and testing ranges) could experience higher levels of activity involving multiple stressors, which could result in a higher potential risk for impacts on *Sargassum* within those areas. The potential for seagrasses and attached macroalgae to be exposed to multiple stressors would be low because activities are not concentrated in areas with depths less than 26 m (85.3 ft.). The combined impacts of all stressors would not be expected to impact marine vegetation populations because: (1) activities involving more than one stressor are generally short in duration, (2) such activities are dispersed throughout the Study Area, and (3) activities are generally scheduled where previous activities have occurred. The aggregate effect on marine vegetation would not observably differ from existing conditions.

3.7.4.2 Endangered Species Act Determinations

Navy training and testing activities would have no effect on Johnson's seagrass because the proposed training and testing activities would not overlap with populations of Johnson's seagrass. Consequently, the Proposed Action would have no effect on Johnson's seagrass critical habitat.

3.7.4.3 Essential Fish Habitat Determinations

Pursuant to the Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of metal, chemical, and other material contaminants during training and testing activities will have no adverse impact on marine vegetation that constitutes Essential Fish Habitat or Habitat Areas of Particular Concern. The use of explosives and other impulsive sources, vessel movement, in-water devices, military expended materials, and seafloor devices during training and testing activities may have an adverse effect on Essential Fish Habitat by reducing the quality and quantity of marine vegetation that constitutes Essential Fish Habitat or Habitat Areas of Particular Concern. The AFTT Essential Fish Habitat Assessment report states that individual stressor impacts to marine vegetation were all either no effect or minimal, and ranged in duration from temporary to long-term, depending on the habitat impacted (U.S. Department of the Navy 2013).

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3.8 MARINE INVERTEBRATES

MARINE INVERTEBRATES SYNOPSIS

The Navy considered all potential stressors and analyzed the following for marine invertebrates:

- Acoustic (sonar and other non-impulsive acoustic sources, and explosives and other impulsive acoustic sources)
- Energy (electromagnetic devices and high energy lasers)
- Physical disturbance and strikes (vessels and in-water devices, military expended materials, and seafloor devices)
- Entanglement (fiber optic cables, guidance wires, and parachutes)
- Ingestion (military expended materials)
- Secondary (explosives and byproducts, metals, chemicals, and other materials)

Preferred Alternative

- Acoustics: Pursuant to the Endangered Species Act (ESA), the use of all non-impulsive and impulsive acoustic sources will have no effect on ESA-listed or proposed coral species. The use of all non-impulsive and impulsive acoustic sources will have no effect on elkhorn and staghorn critical habitat.
- Energy: Pursuant to the ESA, the use of electromagnetic devices and high energy lasers will have no effect on ESA-listed or proposed coral species. The use of electromagnetic devices and high energy lasers will have no effect on critical habitat.
- Physical Disturbance and Strikes: Pursuant to the ESA, the use of vessels and in-water devices will have no effect on ESA-listed or proposed coral species. The use of military expended materials and seafloor devices may affect but is not likely to adversely affect ESA-listed or proposed coral species. The use of vessels, in-water devices, and seafloor devices would have no effect on critical habitat. The use of military expended materials may affect but is not likely to adversely affect critical habitat.
- Entanglement: Pursuant to the ESA, the use of fiber optic cables, guidance wires and parachutes will have no effect on ESA-listed or proposed coral species.
- Ingestion: Pursuant to the ESA, the potential for ingestion of military expended materials will have no effect on ESA-listed or proposed coral species.
- Secondary: Pursuant to the ESA, secondary stressors may affect but are not likely to adversely affect ESA-listed or proposed coral species and may affect but are not likely to adversely affect critical habitat.
- Pursuant to the Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of sonar and other acoustic sources, vessel noise, swimmer defense airguns, weapons firing noise, electromagnetic sources, high energy lasers, vessel movement, in-water devices, and metal, chemical, or other material contaminants will have no adverse effect on sedentary invertebrate beds or reefs that constitute Essential Fish Habitat or Habitat Areas of Particular Concern. The use of electromagnetic sources will have minimal and temporary adverse impact to invertebrates occupying water column Essential Fish Habitat or Habitat Areas of Particular Concern. The use of explosives, pile driving, military expended materials, seafloor devices, and explosives and explosion byproduct contaminants may have an adverse effect on Essential Fish Habitat by reducing the quality and quantity of sedentary invertebrate beds or reefs that constitute Essential Fish Habitat or Habitat Areas of Particular Concern.

3.8.1 INTRODUCTION

In this Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS), marine invertebrates are evaluated based on their distribution and life history relative to the stressor or activity being considered. Activities are evaluated for their potential impact on marine invertebrates in general and are evaluated separately by taxonomic and regulatory groupings as appropriate.

Invertebrates are animals without backbones, and marine invertebrates are a large and diverse group of at least 50,000 species (Brusca and Brusca 2003). Many of these species are important to humans ecologically and economically, providing essential ecosystem services (coastal protection) and income from tourism and commercial and recreational fisheries (Spalding et al. 2001). Because marine invertebrates occur in all habitats, activities that interact with the water column or the seafloor have the potential to impact numerous zooplankton (invertebrates not generally visible to the naked eye), eggs, larvae, larger invertebrates living in the water column, and benthic invertebrates that live on or in the seafloor. The greatest densities of marine invertebrates are usually on the seafloor (Sanders 1968); therefore, activities that contact the seafloor have greater potential for impact.

The following subsections provide brief introductions to the Endangered Species Act (ESA) listed species, federally managed species, habitat types, and major taxonomic groups of marine invertebrates that occur in the Study Area. Federally managed marine invertebrate species regulated under the Magnuson-Stevens Fishery Conservation and Management Act are described in Section 3.8.1.2 (Federally Managed Species), as well as in the Atlantic Fleet Training and Testing (AFTT) Essential Fish Habitat Assessment (U.S. Department of the Navy 2013). The National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS), Office of Protected Resources maintains a website that provides additional information on the biology, life history, species distribution (including maps), and conservation of invertebrates.

3.8.1.1 Endangered Species Act Species

Eleven invertebrate species in the Study Area are listed as threatened, proposed endangered, proposed threatened, or species of concern under the ESA (National Oceanic and Atmospheric Administration 2010c)(Table 3.8-1). Two threatened coral species proposed for reclassification from threatened to endangered and seven other coral species proposed for listing as threatened or endangered under the ESA are discussed in Sections 3.8.2.3 (Elkhorn Coral [*Acropora palmata*]) through Section 3.8.2.11 (Lamarck's Sheet Coral [*Agaricia lamarcki*]). In addition, one species (queen conch) is included as a candidate for listing under the ESA as discussed in Section 3.8.2.12, Queen Conch (*Lobatus gigas*). Species of concern are those for which NMFS has some concern regarding status and threats but insufficient information is available to indicate a need to list them under the ESA. The one species of concern within the Study Area is discussed in Section 3.8.2.15.2 (Deep-Water Corals). Emphasis on species-specific information in the following species descriptions is placed on the nine ESA-listed or proposed species because any threats to or potential impacts on those species are subject to consultation with regulatory agencies.

Table 3.8-1: Status and Presence of Endangered Species Act Listed, Candidate, and Species of Concern Invertebrate Species in the Study Area

Species Name and Regulatory Status[1]			Location in Study Area[2]		
Common Name	**Scientific Name**	**Endangered Species Act Listing**	**Open Ocean**	**Coastal Waters**	**Bays, Rivers, and Estuaries**
Elkhorn coral	*Acropora palmata*	Threatened, Proposed Endangered	North Atlantic Gyre[3]	Gulf of Mexico, Southeast U.S. Continental Shelf, Caribbean Sea	Florida Bay and Biscayne Bay
Staghorn coral	*Acropora cervicornis*	Threatened, Proposed Endangered	North Atlantic Gyre[3]	Gulf of Mexico, Southeast U.S. Continental Shelf, Caribbean Sea	Florida Bay and Biscayne Bay
Boulder star coral	*Montastraea annularis*	Proposed Endangered	North Atlantic Gyre[3]	Gulf of Mexico, Southeast U.S. Continental Shelf, Caribbean Sea	Florida Bay and Biscayne Bay
Mountainous star coral	*Montastraea faveolata*	Proposed Endangered	North Atlantic Gyre[3]	Gulf of Mexico, Southeast U.S. Continental Shelf, Caribbean Sea	Florida Bay and Biscayne Bay
Pillar coral	*Dendrogyra cylindrus*	Proposed Endangered	North Atlantic Gyre[3]	Gulf of Mexico, Southeast U.S. Continental Shelf, Caribbean Sea	Florida Bay and Biscayne Bay
Rough cactus coral	*Mycetophyllia ferox*	Proposed Endangered	North Atlantic Gyre[3]	Gulf of Mexico, Southeast U.S. Continental Shelf, Caribbean Sea	Biscayne Bay
Star coral	*Montastraea franksi*	Proposed Endangered	North Atlantic Gyre[3]	Gulf of Mexico, Southeast U.S. Continental Shelf, Caribbean Sea	Florida Bay and Biscayne Bay
Elliptical star coral	*Dichocoenia stokesii*	Proposed Threatened	North Atlantic Gyre[3]	Gulf of Mexico, Southeast U.S. Continental Shelf, Caribbean Sea	Florida Bay and Biscayne Bay
Lamarck's sheet coral	*Agaricia lamarcki*	Proposed Threatened	North Atlantic Gyre[3]	Gulf of Mexico, Southeast U.S. Continental Shelf, Caribbean Sea	Biscayne Bay
Queen conch	*Lobatus gigas*	Candidate species	North Atlantic Gyre[3]	Gulf of Mexico, Southeast U.S. Continental Shelf, Caribbean Sea	Florida Bay and Biscayne Bay
Ivory tree coral	*Oculina varicosa*	Species of Concern	None	Gulf of Mexico, Southeast U.S. Continental Shelf, Caribbean Sea	None

1 ESA listing status (National Oceanic and Atmospheric Administration 2010c).
2 Presence in the Study Area is characterized by biogeographic units: open-ocean oceanographic features (Labrador Current, Gulf Stream, and North Atlantic Gyre) or by coastal waters of large marine ecosystems (Caribbean Sea, Gulf of Mexico, Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf, and West Greenland Shelf) in the Study Area.
3 Presence in the North Atlantic Gyre is limited to portions of Puerto Rico and the U.S. Virgin Islands.

3.8.1.2 Federally Managed Species

Federally managed species of marine invertebrates are listed in Table 3.8-2. In the context of federally managed species, the term "fishery" applies to any biologically generated object extracted from the ocean (e.g., there is a lobster "fishery" even though the animals are not fish). Assessments in Section 3.8.3 (Environmental Consequences) combine federally managed species with the rest of their taxonomic group (e.g., the Atlantic sea scallop [*Placopecten magellanicus*] is assessed in combination with phylum Mollusca) unless impacts or differential effects warrant separate treatment. Analysis of impacts on commercial and recreational fisheries is provided in Section 3.11 (Socioeconomic Resources).

Table 3.8-2: Federally Managed Marine Invertebrate Species with Essential Fish Habitat within the Study Area, Covered under Each Fishery Management Plan

New England Fishery Management Council[1]	
Atlantic Sea Scallop Fishery Management Plan	
Common Name	**Species**
Atlantic sea scallop	*Placopecten magellanicus*
Red Crab Fishery Management Plan	
Common Name	**Species**
Deep-sea red crab	*Chaceon quinquedens*
Mid-Atlantic Fishery Management Council[1]	
Atlantic Mackerel, Squid, and Butterfish Fishery Management Plan	
Common Name	**Species**
Short-finned squid	*Ilex illecebrosus*
Long-finned squid	*Loligo pealei*
Atlantic Surf Clam and Ocean Quahog Fishery Management Plan	
Common Name	**Species**
Atlantic surf clam	*Spisula solidissima*
Ocean quahog	*Arctica islandica*
South Atlantic Fishery Management Council[2]	
Coral, Coral Reefs and Live/Hard Bottom Habitats of the South Atlantic Region Fishery Management Plan	
Common Name	**Species**
Black corals	Numerous species within coral groups[3]
Fire corals	
Hydrocorals	
Octocorals	
Stony corals	

1 Jurisdiction overlaps with the northern half of the Northeast U.S. Continental Shelf Large Marine Ecosystem and a portion of the Gulf Stream Open Ocean Area.
2 Jurisdiction overlaps with the southernmost portion of the Northeast Continental Shelf Large Marine Ecosystem, the Southeast Continental Shelf Large Marine Ecosystem, the northernmost portion of the Caribbean Sea Large Marine Ecosystem, the easternmost portion of the Gulf of Mexico Large Marine Ecosystem, and portions of the Gulf Stream Open Ocean Area.
3 For a complete list of species in the Corals, Coral Reefs, and Hard/Live Bottom Fishery Management Plans, see the website maintained by the South Atlantic Fishery Management Council.

Table 3.8-2: Federally Managed Marine Invertebrate Species with Essential Fish Habitat within the Study Area, Covered under Each Fishery Management Plan (Continued)

South Atlantic Fishery Management Council[2] (Continued)	
South Atlantic Golden Crab Fishery Management Plan	
Common Name	**Species**
Golden crab	*Chaceon fenneri*
Jonah crab	*Cancer borealis*
Red crab	*Chaceon quinquedens*
South Atlantic Shrimp Fishery Management Plan	
Common Name	**Species**
Pink shrimp	*Farfantepenaeus duorarum*
Brown shrimp	*Farfantepenaeus aztecus*
Rock shrimp	*Sicyonia brevirostris*
Royal red shrimp	*Pleoticus robustus*
White shrimp	*Litopenaeus setiferus*
Gulf of Mexico/South Atlantic Spiny Lobster Fishery Management Plan[4]	
Common Name	**Species**
Spiny lobster	*Panulirus argus*
Gulf of Mexico Shrimp Fishery Management Plan	
Common Name	**Species**
Brown shrimp	*Farfantepenaeus aztecus*
Pink shrimp	*Farfantepenaeus duorarum*
Royal red shrimp	*Pleoticus robustus*
White shrimp	*Litopenaeus setiferus*
Coral and Coral Reefs of the Gulf of Mexico Fishery Management Plan	
Common Name	**Species**
Black corals	Multiple species within coral groups[5]
Fire corals	
Hydrocorals	
Octocorals	
Stony corals	

[2] Jurisdiction overlaps with the southernmost portion of the Northeast U.S. Continental Shelf Large Marine Ecosystem, the Southeast U.S. Continental Shelf Large Marine Ecosystem, the northernmost portion of the Caribbean Sea Large Marine Ecosystem, the easternmost portion of the Gulf of Mexico Large Marine Ecosystem, and portions of the Gulf Stream Open Ocean Area.
[4] Jurisdiction overlaps with the Gulf of Mexico Large Marine Ecosystem and the northernmost portion of the Caribbean Sea Large Marine Ecosystem.
[5] For a complete list of species in the Corals and Coral Reefs Fishery Management Plan, see the website maintained by the Gulf of Mexico Fishery Management Council.

Table 3.8-2: Federally Managed Marine Invertebrate Species with Essential Fish Habitat within the Study Area, Covered under Each Fishery Management Plan (Continued)

South Atlantic Fishery Management Council[2] (Continued)	
Caribbean Fishery Management Council[6]	
Caribbean Spiny Lobster Fishery Management Plan	
Common Name	**Species**
Caribbean spiny lobster	*Panulirus argus*
Caribbean Queen Conch Fishery Management Plan	
Common Name	**Species**
Queen conch	*Lobatus gigas* (formerly named *Strombus gigas*)
Caribbean Corals & Reef Associated Plants and Invertebrates Fishery Management Plan	
All coral and sea grass[7]	
Innumerable aquarium trade species are listed for data collection purposes only[7]	

[2] Jurisdiction overlaps with the southernmost portion of the Northeast U.S. Continental Shelf Large Marine Ecosystem, the Southeast U.S. Continental Shelf Large Marine Ecosystem, the northernmost portion of the Caribbean Sea Large Marine Ecosystem, the easternmost portion of the Gulf of Mexico Large Marine Ecosystem, and portions of the Gulf Stream Open Ocean Area.
[6] Jurisdiction overlaps with a portion of the Caribbean Sea Large Marine Ecosystem and a portion of the North Atlantic Gyre Open Ocean Area.
[7] For a complete list of species in the Caribbean Corals and Reef Associated Invertebrates Fishery Management Plan, see the website maintained by the Caribbean Fishery Management Council.

3.8.1.3 Taxonomic Groups

All marine invertebrate taxonomic groups are represented in the Study Area. Major invertebrate phyla (taxonomic rank)—those with greater than 1,000 species (Appeltans et al. 2010)—and the general zones they inhabit in the Study Area are listed in Table 3.8-3. Throughout the marine invertebrate section, organisms will often be referred to by their phylum name, or more generally, as marine invertebrates.

Table 3.8-3: Major Taxonomic Groups of Marine Invertebrates in the Study Area

Major Invertebrate Groups[1]		Vertical Distribution Within the Study Area[2]		
Common Name (Taxonomic Group)	**Description**	**Open Ocean Areas**	**Large Marine Ecosystems**	**Bays, Rivers, and Estuaries**
Kingdom Protozoa[3] (phyla Foraminifera, Sarcodina, Ciliophora)	Bottom-dwelling and pelagic single-celled organism; shells typically made of calcium carbonate or silica.	Water column, bottom	Water column, bottom	Water column, bottom
Sponges (phylum Porifera)	Bottom-dwelling animals; large species have calcium carbonate or silica structures embedded in cells to provide structural support.	Bottom	Bottom	Bottom
Corals, hydroids, jellyfish (phylum Cnidaria)	Bottom-dwelling and pelagic animals with stinging cells.	Water column, bottom	Water column, bottom	Water column, bottom
Flatworms (phylum Platyhelminthes)	Mostly bottom-dwelling; simplest form of marine worm with a flattened body.	Water column, bottom	Water column, bottom	Water column, bottom
Ribbon worms (phylum Nemertea)	Bottom-dwelling marine worms with a long extension from the mouth (proboscis) that helps capture food.	Bottom	Bottom	Bottom
Round worms (phylum Nematoda)	Small bottom-dwelling marine worms; many live in close association with other animals (typically as parasites).	Water column, bottom	Water column, bottom	Water column, bottom
Segmented worms (phylum Annelida)	Mostly bottom-dwelling, highly mobile marine worms; many tube-dwelling species.	Bottom	Bottom	Bottom
Bryozoans (phylum Ectoprocta)	Lace-like animals that exist as filter-feeding colonies attached to the seafloor.	Bottom	Bottom	Bottom
Squid, bivalves, clams, quahog, sea snails, chitons, conchs (phylum Mollusca)	Molluscs are a diverse group of soft-bodied invertebrates with a specialized layer of tissue called a mantle. Molluscs such as squid are active swimmers and predators, while others such as sea snails are predators or grazers and clams are filter feeders.	Water column, bottom	Water column, bottom	Water column, bottom
Shrimp, crab, lobster, barnacles, copepods (phylum Arthropoda)	Bottom-dwelling or pelagic; some are immobile; with an external skeleton; all feeding modes from predator to filter feeder.	Water column, bottom	Water column, bottom	Water column, bottom
Sea stars, sea urchins, sea cucumbers (phylum Echinodermata)	Bottom-dwelling predators and filter feeders with tube feet.	Bottom	Bottom	Bottom

1 Major taxonomic groups (those with more than 1,000 species) are based on the *World Register of Marine Species* (Appeltans et al. 2010) and *Catalogue of Life* (Bisby et al. 2010).
2 Distribution is listed for adult stages. Except for flatworms and roundworms, most members of invertebrate phyla have free-swimming planktonic larval stages.
3 Classification schemes for Protozoa are unstable, and these phyla represent some of the conventional protozoan groupings.

3.8.2 AFFECTED ENVIRONMENT

Marine invertebrates occur in the world's oceans from warm shallow waters to cold deep waters. They inhabit the seafloor and water column in all the large marine ecosystems (West Greenland, Newfoundland-Labrador Shelf, Scotian Shelf, Northeast United States (U.S.) Continental Shelf, Southeast U.S. Continental Shelf, Gulf of Mexico, and Caribbean Sea) and open ocean areas (Labrador Current, Gulf Stream, and North Atlantic Gyre) in the Study Area (Section 3.0, Introduction, and the Study Area/large marine ecosystem map [Figure 3.0-1]) (Brusca and Brusca 2003). The Study Area extends from the seafloor up to the mean high tide line (often termed mean high water in literature).

Marine invertebrate distribution in the Study Area is influenced by habitat and physical and chemical aspects of the water (e.g., depth, temperature, salinity, nutrient concentrations, and ocean currents) (Levinton 2009). Distribution of invertebrates in the Atlantic portion of the Study Area is also influenced by their distance from the equator (latitude) (Macpherson 2002); in general, the number of marine invertebrate species increases toward the equator (Macpherson 2002). The higher number of species (diversity) and abundance of marine invertebrates in coastal water habitats, compared with the open ocean, is a result of the food and protection that coastal water habitats provide (Levinton 2009).

Marine invertebrates are the dominant animals in all habitats of the Study Area. The diversity and abundance of Arthropoda (e.g., crabs, lobsters, and barnacles) and Mollusca (e.g., snails and clams) is highest on the seafloor over the continental shelf due to high productivity and complex habitats relative to typical soft bottom habitat of the deep ocean (Karleskint et al. 2006). They are important in the marine food web as prey for many higher organisms (e.g., fish and whales), as scavengers and recyclers of nutrients, and as habitat-forming organisms. Every sessile invertebrate is habitat-forming; in a strict sense, even many motile marine invertebrates are habitat-forming. The principal habitat-forming invertebrates are Porifera (e.g., sponges), Cnidaria (e.g., corals), Annelida (e.g., tube worms), and Mollusca (e.g., oysters). Section 3.3 (Marine Habitats) lists the types of habitats in relation to biogeographic units, modified from the Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979). The description of habitats in this section is limited to marine invertebrates that are used to define the habitat type or are habitat-forming. The abiotic (nonliving) components of all habitat types are addressed in Section 3.3 (Marine Habitats), and key marine vegetation components are discussed in Section 3.7 (Marine Vegetation).

Marine invertebrates also occur in open ocean areas. The highly migratory short-finned squid (*Ilex illecebrosus*) occurs seasonally around the Gulf Stream Open Ocean Area (Hendrickson 2006), and the North Atlantic Gyre Open Ocean Area is home to reef-building corals in the islands of Bermuda (Aronson et al. 2008c, e). The existence of these reefs outside the general boundaries for coral reefs is due to the warm water the Gulf Stream carries to Bermuda (Spalding et al. 2001). Also, deep-water coral communities occur in the Study Area. Several hard coral species make up these reefs, but only the two dominant species are federally managed (i.e., ivory tree coral [*Oculina varicosa*] and *Lophelia pertusa*). *Oculina varicosa* reefs are most abundant off the southeast coast of the United States, but *Lophelia pertusa* is found throughout the Study Area at depths of 650–2,600 feet (ft.) (200–800 meters [m]), with the exception of the West Greenland Shelf Large Marine Ecosystem and the Labrador Current Open Ocean Area (although Freiwald et al. (2004) suggested that this is not a true absence but rather reflects insufficient survey intensity) (National Oceanic and Atmospheric Administration 2010a; National Oceanic and Atmospheric Administration and U.S. Department of Commerce 2010; Reed et al. 2006) (Section 3.8.2.15.2 [Deep-Water Corals] for a discussion of deep-water coral habitat).

3.8.2.1 Invertebrate Hearing and Vocalization

Very little is known about sound detection and use of sound by aquatic invertebrates (Budelmann 1992a, b; Montgomery et al. 2006; Popper et al. 2001). Organisms may detect sound by sensing either the particle motion or pressure component of sound, or both (Section 3.0.4, Acoustic and Explosives Primer). Aquatic invertebrates probably do not detect pressure since many are generally the same density as water and few, if any, have air cavities that would function like the fish swim bladder in responding to pressure (Budelmann 1992b; Popper et al. 2001). Many aquatic invertebrates, however, have ciliated "hair" cells that may be sensitive to water movements, such as those caused by currents or water particle motion very close to a sound source (Budelmann 1992a, b; Mackie and Singla 2003). This may allow sensing of nearby prey or predators or help with local navigation.

Aquatic invertebrates that can sense local water movements with ciliated cells include cnidarians, flatworms, segmented worms, urochordates (tunicates), molluscs, and arthropods (Budelmann 1992a, b; Popper et al. 2001). The sensory capabilities of corals are largely limited to detecting water movement using receptors on their tentacles (Gochfeld 2004), and the exterior cilia of coral larvae likely help them detect nearby water movements (Vermeij et al. 2010). Some aquatic invertebrates have specialized organs called statocysts for determination of equilibrium and, in some cases, linear or angular acceleration. Statocysts allow an animal to sense movement and may enable some species, such as cephalopods and crustaceans, to be sensitive to water particle movements associated with sound (Hu et al. 2009; Kaifu et al. 2008; Montgomery et al. 2006; Popper et al. 2001). Because any acoustic sensory capabilities, if present at all, are limited to detecting water motion, and water particle motion near a sound source falls off rapidly with distance, aquatic invertebrates are probably limited to detecting nearby sound sources rather than sound caused by pressure waves from distant sources.

Both behavioral and auditory brainstem response studies suggest that crustaceans may sense sounds up to 3 kilohertz (kHz), but best sensitivity is likely below 200 Hertz (Hz) (Goodall et al. 1990; Lovell et al. 2005; Lovell et al. 2006). Most cephalopods (e.g., octopus and squid) likely sense low-frequency sound below 1,000 Hz, with best sensitivities at lower frequencies (Budelmann 1992b; Mooney et al. 2010; Packard et al. 1990). A few may sense higher frequencies up to 1,500 Hz (Hu et al. 2009). Squid did not respond to toothed whale ultrasonic echolocation clicks at sound pressure levels ranging from 199 to 226 decibels (dB) referenced to (re) 1 µ (micro) Pascal (Pa) peak-to-peak, likely because these clicks were outside of squid hearing range (Wilson et al. 2007). However, squid exhibited alarm responses when exposed to broadband sound from an approaching seismic airgun with received levels exceeding 156 to 161 dB re 1 µPa root mean square (McCauley et al. 2000b).

Aquatic invertebrates may produce and use sound in territorial behavior, to deter predators, to find a mate, and to pursue courtship (Popper et al. 2001). Some crustaceans produce sound by rubbing or closing hard body parts together, such as lobsters (Au and Banks 1998; Latha et al. 2005; Patek and Caldwell 2006). The snapping shrimp chorus makes up a significant portion of the ambient noise in many locales (Au and Banks 1998; Cato and Bell 1992). Each click is up to 215 dB re 1 µPa, with a peak around 2 to 5 kHz (Au and Banks 1998; Heberholz and Schmitz 2001). Other crustaceans make low-frequency rasping or rumbling noises, perhaps used in defense or territorial display, that may be obscured by high levels of ambient noise at ranges greater than 1 m from the source (Patek and Caldwell 2006; Patek et al. 2009).

Reef sounds, such as fish pops and grunts, sea urchin grazing (around 1.0 kHz to 1.2 kHz), and snapping shrimp clicks (around 5 kHz) (Radford et al. 2010), may be used as cues by some aquatic invertebrates. Nearby reef sounds were observed to affect movements and settlement behavior of coral and crab larvae (Jeffs et al. 2003; Radford et al. 2007; Stanley et al. 2010; Vermeij et al. 2010). Larvae of other crustacean species, including pelagic and nocturnally emergent species that benefit from avoiding predators associated with coral reefs, appear to avoid reef sounds (Simpson et al. 2011). Detection of reef sounds is likely limited to short distances (less than 330 ft. [100 m]) (Vermeij et al. 2010).

3.8.2.2 General Threats

General threats to marine invertebrates include overexploitation and destructive fishing practices (Halpern et al. 2008; Jackson et al. 2001; Kaiser et al. 2002; Miloslavich et al. 2011; Pandolfi et al. 2003), habitat degradation by pollution and coastal development (Cortes and Risk 1985; Downs et al. 2009; Mearns et al. 2011), and invasive species (Bryant et al. 1998; Galloway et al. 2009; Wilkinson 2002). These threats are compounded by global threats to all marine life, including increasing temperature and decreasing pH of the ocean linked to global climate change (Canning-Clode et al. 2011; Cohen et al. 2009; Doney et al. 2012; Miloslavich et al. 2011).

The health and abundance of marine invertebrates is vital to the marine ecosystem, the sustainability of the world's commercial fisheries (Pauly et al. 2002), and to U.S. obligations to conserve biodiversity at national and international levels (Mengerink et al. 2009). Marine invertebrates are harvested for food and for the aquarium trade. Economically important invertebrate groups that are commercially fished for food in the United States are crustaceans (e.g., shrimps, lobsters, and crabs), bivalves (e.g., scallops, clams, and oysters), and cephalopods (e.g., squid and octopuses) (Gulf of Mexico Fishery Management Council 2005; Hendrickson 2006; South Atlantic Fishery Management Council 1998a, b). These fisheries are a key part of the commercial fisheries industry in the United States (Food and Agriculture Organization of the United Nations 2005). Global threats to crustaceans, bivalves, and cephalopods are largely the result of overfishing, destructive fishing techniques (e.g., trawling) and habitat modification (Morgan and Chuenpagdee 2003; Pauly et al. 2002). A relatively new threat to invertebrates is bioprospecting, the collection of organisms for the purpose of finding new compounds for pharmaceutical products. A review by Hunt and Vincent (2006) reveals that coastal waters of the entire Study Area are subject to intense bioprospecting. In the Study Area, marine invertebrates that are managed to ensure their sustainability have delineated Essential Fish Habitat, which is designated by NMFS and regional fishery management councils (see Table 3.8-2 for a list of marine invertebrates managed by regional fishery management councils).

Exposure to oil runoff from land, natural seepage, or spills from offshore drilling or tankers is an additional threat that can impact marine invertebrates (White et al. 2012). Factors such as the oil type, quantity, exposure time, and season can affect organism toxicity levels. Even closely related organisms can be affected differently. For example, the ESA-listed elkhorn (*Acropora palmata*) and staghorn (*Acropora cervicornis*) corals are less resistant to oil than other types of coral (National Oceanic and Atmospheric Administration 2001). Reproductive and early life stages are especially sensitive to oil exposure. Overall, the impact of oil spills on marine invertebrates is poorly documented, but experiments using corals indicate that oil exposure can result in death, delayed reproduction, altered development and growth, and altered behavior (National Oceanic and Atmospheric Administration 2001; White et al. 2012). Additional information on the biology, life history, and conservation of marine invertebrates can be found on the websites maintained by the following organizations:

- NMFS, particularly for ESA-listed species, ESA-proposed species, species of concern, and candidate species
- U.S. Coral Reef Task Force
- MarineBio Conservation Society

In the Study Area, nine coral and one mollusc species are endangered, threatened, proposed, or candidate species under the ESA. The following sections include the descriptions of the ESA species and descriptions of the major marine invertebrate taxonomic groups that occur in the Study Area. These taxonomic group descriptions include descriptions of key habitat-forming invertebrates, including reef-forming sponges, shallow-water corals, two groups of key deep-water corals that form Essential Fish Habitat, corals and other organisms that define live hard bottom, reef-building worms, and reef-building molluscs (e.g., oysters).

The ESA listing process for 82 species of reef-building corals petitioned by the Center for Biological Diversity (Sakashita and Wolf 2009) is the broadest and most complex listing process undertaken by NMFS (Brainard et al. 2011). A rigorous threat evaluation was developed for these corals by Brainard et al. (2011) and used by NMFS in their ESA determinations. Nineteen key threats were selected as the most important factors influencing the potential extinction of candidate coral species before 2100 (Table 3.8-4). However, NMFS used only nine of these threats in determining if ESA listing was warranted (FR *77*(236): 73219 – 73262, December 7, 2012). Because most of these threats are also known to affect marine invertebrate groups, generally, the information is presented here in General Threats rather than within a subsequent subsection.

Table 3.8-4: Summary of Proximate Threats and Their Relative Importance to Extinction Risk for Coral Species

Proximate Threat[1]	Importance to Extinction Risk	Used by NMFS in Coral ESA Determinations
Ocean Warming	High	✓
Disease	High	✓
Ocean Acidification	Med-High	✓
Reef Fishing—Trophic Effects	Medium	✓
Sedimentation	Low-Medium	✓
Nutrients	Low-Medium	✓
Sea-Level Rise	Low-Medium	✓
Toxins	Low	
Changing Ocean Circulation	Low	
Changing Storm Tracks/Intensities	Low	
Predation	Low	✓
Reef Fishing—Habitat Impacts/Destructive Fishing Practices	Low	
Ornamental Trade	Low	✓
Natural Physical Damage	Low	
Human-Induced Physical Damage	Negligible-Low	
Aquatic Invasive Species	Negligible-Low	
Salinity	Negligible	
African/Asian Dust	Negligible	
Changes in Incoming Solar Radiation	Probably Negligible	

ESA: Endangered Species Act; NMFS: National Marine Fisheries Service

[1] As summarized by Brainard et al. (2011). The authors note that excepting "natural physical damage" and "changes in incoming solar radiation," the ultimate factor for all of the proximate threats is growth in human population and consumption of natural resources.

3.8.2.3 Elkhorn Coral (*Acropora palmata*)

3.8.2.3.1 Status and Management

Elkhorn coral is designated as a threatened species under the ESA (National Marine Fisheries Service 2010) and is proposed as an endangered species (FR *77*(236): 73219 – 73262, December 7, 2012). The critical habitat designation for threatened elkhorn and staghorn corals identifies the physical or biological features essential to their conservation as "substrate of suitable quality and availability to support larval settlement and recruitment, and reattachment and recruitment of asexual fragments." For purposes of this definition, "substrate of suitable quality and availability" means natural consolidated hard substrate or dead coral skeleton that is free from fleshy or turf macroalgae cover and sediment cover (FR *73*(229): 72210-72241, November 26, 2008). This definition applies to depths from mean low water to 30 m (FR *73*(229): 72210-72241, November 26, 2008). No other primary constituent elements were sufficiently definable. While most shallow-water coral habitat in the Study Area falls within the definition of critical habitat for elkhorn and staghorn, the United States contains only 10 percent, approximately, of all potential critical habitat in the Caribbean (Bryant et al. 1998).

The species' four areas of critical habitat (FR *73*(229): 72210-72241, November 26, 2008) are the Florida area (1,003 square nautical miles [nm^2]), the Puerto Rico area (1,123 nm^2), the St. John/St. Thomas area (91 nm^2), and the St. Croix area (95 nm^2); see Figure 3.8-1. All these areas of critical habitat are within U.S. waters of the Study Area. Although areas adjacent to the Naval Air Station Key West and within the footprint of the South Florida Ocean Measurement Facility Testing Range include areas that meet the definition of elkhorn critical habitat, areas within 0.02 nm of Naval Air Station Key West and a small portion of the nearshore footprint of the South Florida Ocean Measurement Facility Testing Range have been exempted from the critical habitat designation (FR *73*(229): 72210-72241, November 26, 2008).

3.8.2.3.2 Habitat and Geographic Range

Elkhorn coral is found in outer reef crests and slopes with exposure to wave action at depths of less than 3–66 ft. (1–20 m), although it has been reported as deep as 30 m (Aronson et al. 2008b; Boulon et al. 2005). The optimal water temperature for elkhorn coral is 77 degrees Fahrenheit (°F) to 84°F (25 degrees Celsius [°C] to 29°C), and it requires a salinity range of 34–37 parts per thousand (Aronson et al. 2008b; Boulon et al. 2005; Goreau and Wells 1967). Elkhorn coral inhabits shallow waters with high oxygen content and low nutrient levels (Spalding et al. 2001). Clear, shallow water allows the coral sufficient sunlight exposure to support zooxanthellae (symbiotic photosynthetic organisms; analogous to plants living inside the animals). Elkhorn coral primarily inhabits the seaward margins of reefs where the previously mentioned conditions are more likely to occur (Ginsburg and Shinn 1964).

Elkhorn coral distribution in the Study Area extends from southeastern Florida through the Florida Keys, and surrounds Puerto Rico and the U.S. Virgin Islands (Aronson et al. 2008b). Recently, a new colony of elkhorn coral was discovered in the Flower Garden Banks National Marine Sanctuary in the Gulf of Mexico (Zimmer et al. 2006), although this is not currently included in elkhorn critical habitat (FR *73*(229): 72210-72241, November 26, 2008). Elkhorn coral is known to occur in portions of the South Florida Ocean Measurement Facility Testing Range (Gilliam and Walker 2011), the Key West Range Complex, and the Puerto Rico/St. Croix Operating Area.

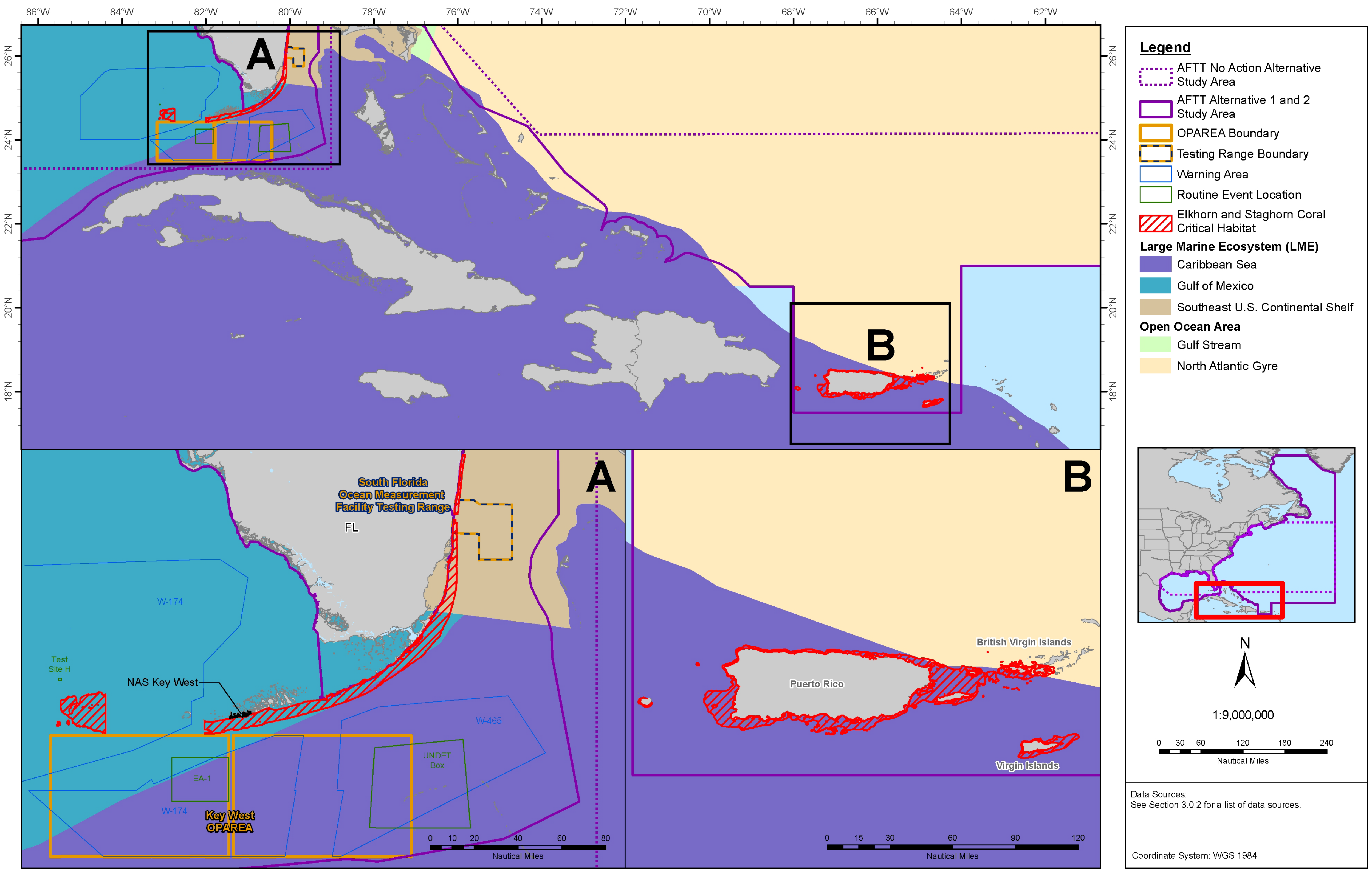

Figure 3.8-1: Critical Habitat Areas for Elkhorn and Staghorn Coral within the Study Area

AFTT: Atlantic Fleet Training and Testing; FL: Florida; NAS: Naval Air Station; OPAREA: Operating Area; UNDET: Underwater Detonation

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Southeast U.S. Continental Shelf, Caribbean Sea, and Gulf of Mexico Large Marine Ecosystems; and North Atlantic Gyre Open Ocean Area. Within the Study Area, elkhorn corals are typically found in the southeastern part of the Gulf of Mexico Large Marine Ecosystem, the northern part of the Caribbean Sea Large Marine Ecosystem, and the southern part of the Southeast U.S. Continental Shelf Large Marine Ecosystem. Elkhorn coral also occurs in the southwestern-most fragments of the North Atlantic Gyre Open Ocean Area adjacent to Puerto Rico and the U.S. Virgin Islands.

3.8.2.3.3 Population and Abundance

Elkhorn coral is in the Acroporidae family of corals. A review of quantitative data of Acroporidae in the wider Caribbean area, including the Florida Keys and Dry Tortugas, indicates a greater than 97 percent reduction of Acroporidae coverage since the 1970s with peak declines in the 1980s (Boulon et al. 2005). The absence of recovery of the Florida Key reefs implies they may no longer be resilient to various stressors (Somerfield et al. 2008). The current range of Acroporidae is considered to be the same as the historical range, despite the more than 97 percent reduction of individuals (Boulon et al. 2005; Bruckner 2003; Rothenberger et al. 2008).

Research on the population status of elkhorn coral indicates a drastic decline. Surveys of Carysfort Reef (1974–1982) and Molasses Reef (1981 and 1986) revealed slight declines or stable colonies (Dustan and Halas 1987; Jaap et al. 1988). It was not until the observation of a 93 percent decrease of coral in Looe Key (1983–2000) that the elkhorn coral populations mirrored the substantial decline of staghorn coral (Miller et al. 2002). Continued long-term monitoring in the Florida Keys and the U.S. Virgin Islands has found that elkhorn coral remains at less than 1 percent of all corals on reefs (Boulon et al. 2005; Rothenberger et al. 2008), and the species’ continued decline since 2004 is attributed principally to fragmentation, disease, and predation (Williams and Miller 2011). Since the 2006 decision to list elkhorn coral as threatened the population has continued to decline by 50 percent or more, recruitment failure has been observed, and genetic studies have shown that approximately half of all colonies are clones—reducing the effective number of genetic individuals (Williams and Miller 2011).

Elkhorn coral can reproduce by spawning annually in August or September (Boulon et al. 2005), or asexually by fragmentation (National Marine Fisheries Service 2010). Although fragmentation of adult colonies helps maintain high growth rates, from 1.6 to 4.3 inches (in.) (4 to 11 centimeters [cm]) per year, fragmentation reduces the reproductive potential of elkhorn coral by delaying the production of eggs and sperm for 4 years after the damage occurs (Lirman 2000). Furthermore, only larger colonies are fertile and capable of sexual reproduction (i.e., those with surface areas greater than 9–39 square inches [$in.^2$] (60–250 square centimeters [cm^2]) (Soong and Lang 1992). Eggs and sperm immediately float to the sea surface where multiple embryos can develop from the fragmentation of a single embryo (Marshall 2012). Developing larvae travel at or near the sea surface for up to several weeks (Boulon et al. 2005) before actively seeking specific micro-habitats suitable for growth (Suzuki et al. 2012). Maturity is reached between 3 and 8 years, the average generation time is 10 years, and longevity is likely longer than 10 years based on average growth rates and size (Wallace 1999). Combined with a severely reduced population, these factors restrict the species' capacity for recovery.

3.8.2.3.4 Predator-Prey Interactions

Predators of corals include sea stars, snails, and fishes (e.g., parrotfish and damselfish) (Boulon et al. 2005; Roff et al. 2011). The marine snail, *Coralliophila abbreviata* (Grober-Dunsmore et al. 2006), and the fireworm, *Hermodice carunculata* (Boulon et al. 2005), are the primary predators on elkhorn coral.

Corals feed on zooplankton, which are small organisms that inhabit the ocean water column. Corals capture prey with tentacles armed with stinging cells that surround the mouth or by employing a mucus-net to catch suspended prey (Brusca and Brusca 2003). In addition to capturing prey, corals possess another unique method of acquiring essential nutrients through their symbiotic relationship with zooxanthellae that benefits both organisms. The coral host provides nitrogen in the form of waste to the zooxanthellae, and the zooxanthellae provide organic compounds produced by photosynthesis (the conversion of sunlight into food) to its host (Brusca and Brusca 2003; Schuhmacher and Zibrowius 1985). Zooxanthellae also provide corals with their characteristic color.

3.8.2.3.5 Species-Specific Threats

Elkhorn coral is more susceptible to disease than many other Caribbean corals (Pandolfi et al. 2003; Patterson et al. 2002; Porter et al. 2001). In particular, elkhorn coral is susceptible to a disease named "white pox" or "acroporid serratiosis" caused by a human fecal bacterium (*Serratia marcescens*). The bacterium is present in other coral species, but causes disease only in elkhorn coral (Sutherland et al. 2011). Additionally, it is susceptible to the same suite of stressors that generally threaten corals (Section 3.8.2.15.1.5, Threats). Contributing to the proposed reclassification of elkhorn coral from threatened to endangered were findings during the status review that the 2006 listing determination "…underestimated the global climate change-associated impacts to *A. palmata* and *A. cervicornis*…" (FR 77(236): 73219 – 73262, December 7, 2012).

NMFS evaluated the population's demographic, spatial structure, and vulnerability factors (Table 3.8-4) to determine whether the species was likely to have an "…extremely high risk of extinction with little chance for recovery…" by 2100 (FR *77*(236): 73219 – 73262, December 7, 2012) (Brainard et al. 2011). Elements that contribute to elkhorn coral's proposed endangered status are: high vulnerability to ocean warming, ocean acidification and disease, high vulnerability to sedimentation and nutrient over-enrichment, uncommon abundance, decreasing trend in abundance, low relative recruitment rate, narrow overall distribution, restriction to the Caribbean, and inadequacy of regulatory mechanisms.

3.8.2.4 Staghorn Coral (*Acropora cervicornis*)

3.8.2.4.1 Status and Management

Staghorn coral is designated as a threatened species under the ESA (FR 71 (89): 26852-26872, May 9, 2006) and is proposed to be listed as endangered (FR *77*(236): 73219 – 73262, December 7, 2012). Staghorn coral shares the four areas of critical habitat with elkhorn coral and two exemptions to critical habitat at U.S. Department of the Navy (Navy) facilities (FR *73*(229): 72210-72241, November 26, 2008) (refer to Section 3.8.2.3.1, Status and Management, for critical habitat information and map [Figure 3.8-1], and general management information).

3.8.2.4.2 Habitat and Geographic Range

Staghorn coral is commonly found in lagoons and the upper to mid-reef slopes, at depths of 3–66 ft. (1–20 m), and requires a salinity range of 34–37 parts per thousand (Aronson et al. 2008a; Boulon et al. 2005) (refer to Section 3.8.2.3.2, Habitat and Geographic Range, as habitat information provided for elkhorn coral applies to staghorn as well). Staghorn coral is known to occur in portions of the Key West Range Complex and the Puerto Rico/St. Croix Operating Area (FR *77*(236): 73219 – 73262, December 7, 2012).

Southeast U.S. Continental Shelf, Caribbean Sea, and Gulf of Mexico Large Marine Ecosystems; and North Atlantic Gyre Open Ocean Area. In the Study Area, staghorn distribution extends south from

Palm Beach, Florida and along the east coast to the Florida Keys and Dry Tortugas (Boulon et al. 2005; Jaap 1984), in the southern part of the Gulf of Mexico Large Marine Ecosystem, the northern part of the Caribbean Sea Large Marine Ecosystem, and the southern part of the Southeast U.S. Continental Shelf Large Marine Ecosystem. Staghorn coral also occurs in the southwestern-most fragments of the North Atlantic Gyre Open Ocean Area adjacent to Puerto Rico and the U.S. Virgin Islands.

3.8.2.4.3 Population and Abundance

Most population monitoring of shallow-water corals is focused on the Florida Keys, which straddle three large marine ecosystems: Southeast U.S. Continental Shelf, Caribbean Sea, and Gulf of Mexico. Because the Florida Keys are an ecological subregion unto themselves, most reports categorize coral data as Floridian versus Caribbean rather than parse out populations on one side of these arbitrary borders. Research on the population status of staghorn coral indicates a drastic decline throughout the Caribbean that peaked in the 1980s. At four long-monitored reefs in the Florida Keys, staghorn coral cover decreased:

- 18 percent on Carysfort Reef (1974–1982) (Dustan and Halas 1987)
- 96 percent on Molasses Reef (1981–1986) (Jaap et al. 1988)
- 98 percent on Looe Key (1983–2000) (Causey et al. 2002)
- 80–98 percent in the Dry Tortugas (Davis 1982)

Continued long-term monitoring in the Florida Keys and the U.S. Virgin Islands has found that staghorn coral remains at two percent or less of all corals on reefs, a fraction of its former abundance (Boulon et al. 2005; Rothenberger et al. 2008). Relatively recent reports found that staghorn coral was infrequently abundant in isolated patches, which suggests that staghorn recovery is somewhat more likely than elkhorn recovery (Bruckner 2003; Rothenberger et al. 2008) (refer to Section 3.8.2.3.3, Population and Abundance, for general population and abundance information regarding acroporid corals). Staghorn coral grown in 'nurseries' to assist recovery programs had substantially higher survival rates after the catastrophic cold-water bleaching event of 2010, suggesting that intervention has multiple benefits (Lirman et al. 2011; Schopmeyer et al. 2011). This same 2010 cold-water event killed an average of 15 percent of staghorn colonies at monitored reefs in the Florida Keys, a substantial decline in this remnant population (Lirman et al. 2011; National Oceanic and Atmospheric Administration 2012c). Since the 2006 decision to list staghorn coral as threatened some populations have continued to decline by 50 percent or more, and reliance on asexual fragmentation as a source of new colonies is not sufficient to prevent extinction (FR *77*(236): 73219 – 73262, December 7, 2012).

Growth rates for this species range from 1.2 to 4.5 in. (3 to 11.5 cm) per year (Boulon et al. 2005). Reproductive strategies and characteristics are not materially different from elkhorn coral (Section 3.8.2.3.3, Population and Abundance).

3.8.2.4.4 Predator-Prey Interactions

Predators of corals include sea stars, snails, and fishes (e.g., parrotfish and damselfish) (Boulon et al. 2005; Roff et al. 2011). The marine snail, *Coralliophila abbreviata* (Grober-Dunsmore et al. 2006), and the fireworm, *Hermodice carunculata* (Boulon et al. 2005), are the primary predators on staghorn coral. Staghorn coral feeding strategies and symbioses are not materially different from elkhorn coral (Section 3.8.2.3, Elkhorn Coral [*Acropora palmata*]).

3.8.2.4.5 Species-Specific Threats

Staghorn coral has no species-specific threats. It is susceptible to the same suite of stressors that generally threaten corals (Section 3.8.2.15.1.5, Threats), although it is more susceptible to disease (Pandolfi et al. 2003; Patterson et al. 2002; Porter et al. 2001). Contributing to the proposed reclassification of staghorn coral from threatened to endangered were findings during the status review that the 2006 listing determination "…underestimated the global climate change-associated impacts to *A. palmata* and *A. cervicornis*…" (FR *77*(236): 73219 – 73262, December 7, 2012).

NMFS evaluated the population's demographic, spatial structure, and vulnerability factors (Table 3.8-4) to determine whether the species was likely to have an "…extremely high risk of extinction with little chance for recovery…" by 2100 (Brainard et al. 2011). Elements that contribute to staghorn coral's proposed endangered status are: high vulnerability to ocean warming, ocean acidification and disease, high vulnerability to sedimentation and nutrient over-enrichment, uncommon abundance, decreasing trend in abundance, low relative recruitment rate, narrow overall distribution, restriction to the Caribbean, and inadequacy of regulatory mechanisms.

3.8.2.5 Boulder Star Coral (*Montastraea annularis*)

3.8.2.5.1 Status and Management

The three species of *Montastraea* proposed for listing as endangered under the ESA (*Montastraea annularis, Montastraea faveolata, Montastraea franksi*) have partially overlapping morphological characteristics, particularly in northern sections of their range, making identification a less-certain process than for most other Caribbean corals. While there now is reasonable acceptance that these are three separate and valid species, decades of taxonomic uncertainty and difficult field identification have led many to consider these a single species complex. Consequently, many long-term monitoring data sets and previous ecological studies did not distinguish among them, instead pooling them together as "*M. annularis* complex" or "*M. annularis* sensu lato" (Brainard et al. 2011; Jaap et al. 2002; National Oceanic and Atmospheric Administration 2012b; Somerfield et al. 2008). The so-called common names are not commonly used for these species; when they are identified in literature and by enthusiasts they are almost invariably called by their scientific names.

In December 2012, NMFS issued a Proposed Rule for reef-building coral species including a proposed listing for boulder star coral (*Montastraea annularis*) as endangered (FR *77*(236): 73219 – 73262, December 7, 2012). The proposed listing is based on a comprehensive status review (Brainard et al. 2011), a summary of management and conservation measures (National Oceanic and Atmospheric Administration 2012b), and a supplemental information report addressing new information and public comment to both status and management reports (National Oceanic and Atmospheric Administration 2012b). Additional information regarding this coral species, including the *Petition to List 83 Coral Species Under the ESA* by the Center for Biological Diversity (Sakashita and Wolf 2009), can be accessed at the website maintained by the NMFS Office of Protected Resources. Critical habitat has not yet been proposed for this species.

3.8.2.5.2 Habitat and Geographic Range

Montastraea species are known to occur from depths of 0.5 to 20 m (1.64 to 65.6 ft.) (Brainard et al. 2011; National Oceanic and Atmospheric Administration 2012b). It occurs in most reef habitat types, though it is less common on the reef flat and in the shallow zones formerly dominated by elkhorn coral (Brainard et al. 2011; Goreau 1959; National Oceanic and Atmospheric Administration 2012b). It is known throughout the Caribbean, Bahamas, and the Flower Garden Banks, but is uncommon or possibly absent from Bermuda.

Boulder star coral range coincides with the Study Area in most areas that shallow-water coral reefs occur. The principal areas of coincidence between boulder star coral habitat and the Study Area are near Puerto Rico and south Florida. Boulder star coral is known to occur in the South Florida Ocean Measurement Facility Testing Range (Gilliam and Walker 2011), adjacent to the Naval Air Station Key West, Key West and Gulf of Mexico Range Complexes, and the Puerto Rico/St. Croix Operating Area. However, some of this geographic range information is based on ecological studies that identified the *M. annularis* complex rather than specifying *M. annularis* in particular.

Southeast U.S. Continental Shelf, Caribbean Sea, and Gulf of Mexico Large Marine Ecosystems, and North Atlantic Gyre Open Ocean Area. Within the Study Area, boulder star coral is typically found in the southern and southeastern parts of the Gulf of Mexico Large Marine Ecosystem, the northern part of the Caribbean Sea Large Marine Ecosystem, and the southern part of the Southeast U.S. Continental Shelf Large Marine Ecosystem. Boulder star coral also occurs in the fragments of the North Atlantic Gyre Open Ocean Area that coincide with coral reef habitat.

3.8.2.5.3 Population and Abundance

Boulder star coral in the U.S. Virgin Islands declined 72 percent during the years from 1988 to 1999 (Edmunds and Elahi 2007). Declines between 40 and 60 percent were recorded in Puerto Rico, and 80 to 95 percent declines were observed in Florida between the late 1970s and 2003 (Aronson et al. 2008d; Brainard et al. 2011). However, because many studies in Puerto Rico and Florida did not reliably distinguish between the three sister-species of the *M. annularis* complex, these changes in abundance should be assumed to apply generally to the *M. annularis* species complex (Brainard et al. 2011). In addition to these declines, the remnant population of *M. annularis* in the Florida Keys was decimated by the 2010 cold-water bleaching event that killed about 56 percent of all *M. annularis* colonies at monitored reefs (Lirman et al. 2011).

All three of the *M. annularis* complex species are hermaphroditic, spawning 4–8 nights after the late summer full moon (typically September and October) (Brainard et al. 2011; Caribbean Marine Biological Institute 2011). Buoyant gametes are fertilized at the surface, larval development is typically 3–8 days and larvae are relatively small (Brainard et al. 2011; Caribbean Marine Biological Institute 2011). Fertilization success is low and recruitment rates are extremely low, on the order of one per 10 square meters (m^2) every 10 years (Brainard et al. 2011). Asexual reproduction by fragmentation is occasionally successful, but in general reproduction rates of this species are extremely low (Aronson et al. 2008d; Brainard et al. 2011). Genetic studies of boulder star coral found that populations in the eastern and western Caribbean are relatively genetically distinct, suggesting that regional differences in population trends or regulations for corals may influence their populations' genetic diversity (Foster et al. 2012).

Growth rates are approximately 1 cm per year for colonies at depths of less than 12 m, and growth rates decrease sharply as depth increases (Brainard et al. 2011). Slow growth coupled with low recruitment rates contribute to the three *M. annularis* complex species' vulnerability to extinction (Brainard et al. 2011).

3.8.2.5.4 Predator and Prey Interactions

Boulder star coral is much less susceptible to predation by snails than the *Acropora* species, and though preyed on by parrotfish the species is not preyed on disproportionately (Brainard et al. 2011; Roff et al.

2011). Boulder star coral feeding strategies and symbioses are not materially different from elkhorn coral (Section 3.8.2.3, Elkhorn Coral).

3.8.2.5.5 Species-Specific Threats

All three species of the *M. annularis* complex are moderately to highly susceptible to thermal bleaching, both warm and cool extremes (Brainard et al. 2011; National Oceanic and Atmospheric Administration 2012b). Recently, boulder star coral and mountainous star coral (*M. annularis* and *M. faveolata*) were found to have higher susceptibility to coral bleaching than many other species (van Hooidonk et al. 2012). Among the 25 coral species assessed after the 2010 cold-water bleaching event in Florida, *M. annularis* was the most susceptible to mortality by almost a factor of two (Lirman et al. 2011). This coral species has no species-specific threats, and is susceptible to the same suite of stressors that generally threaten corals (Section 3.8.2.15.1.5, Threats), although disease and pollution (e.g., the principal pollutants affecting corals are nutrients, herbicides, and pesticides) are the most damaging of the general threats (Brainard et al. 2011; Hughes et al. 2003; Pandolfi et al. 2005).

NMFS evaluated the population's demographic, spatial structure, and vulnerability factors (Table 3.8-4) to determine whether the species was likely to have an "…extremely high risk of extinction with little chance for recovery…" by 2100 (Brainard et al. 2011). Elements that contribute to boulder star coral's (*Montastraea annularis*) proposed endangered status are: high vulnerability to ocean warming disease, and ocean acidification; high vulnerability to sedimentation and nutrient over-enrichment; decreasing trend in abundance; low relative recruitment rate; narrow overall distribution (based on narrow geographic distribution and moderate depth distribution); restriction to the Caribbean; and inadequacy of regulatory mechanisms.

3.8.2.6 Mountainous Star Coral (*Montastraea faveolata*)

3.8.2.6.1 Status and Management

In December 2012, NMFS issued a Proposed Rule for reef-building coral species including a proposed listing for mountainous star coral as endangered (FR *77*(236): 73219 – 73262, December 7, 2012). The proposed listing is based on a comprehensive status review (Brainard et al. 2011), a summary of management and conservation measures (National Oceanic and Atmospheric Administration 2012b), and a supplemental information report addressing new information and public comment to both status and management reports (National Oceanic and Atmospheric Administration 2012b). Additional information regarding this coral species, including the *Petition to List 83 Coral Species Under the ESA* by the Center for Biological Diversity (Sakashita and Wolf 2009), can be accessed at the website maintained by the NMFS Office of Protected Resources. Critical habitat has not yet been proposed for this species.

The so-called common name (mountainous star coral) is not commonly used for this species; when it is identified in literature and by enthusiasts it is almost invariably called by its scientific name.

3.8.2.6.2 Habitat and Geographic Range

Mountainous star coral occurs from 0.5 m to at least as deep as 40 m, and like *M. annularis* it is more commonly found in the shallower portions of this range. The *M. annularis* complex has been reported to at least 70–90 m, though only *M. faveolata* and *M. franksi* are likely to occur at these depths. This species is found in Bermuda but otherwise its geographic range is not materially different from *M. annularis*.

Mountainous star coral is known to occur in the South Florida Ocean Measurement Facility Testing Range (Gilliam and Walker 2011), adjacent to the Naval Air Station Key West, Key West and Gulf of Mexico Range Complexes, and the Puerto Rico/St. Croix Operating Area. However, some of this geographic range information is based on ecological studies that identified the *M. annularis* complex rather than specifying *M. faveolata* in particular.

3.8.2.6.3 Population and Abundance

This species information is assumed not to be materially different from boulder star coral; however, differences may be masked since many ecological studies collected data at the *M. annularis* complex level rather than specifying *M. faveolata* in particular.

3.8.2.6.4 Predator and Prey Interactions

This species information is assumed not to be materially different from boulder star coral; however, differences may be masked since many ecological studies collected data at the *M. annularis* complex level rather than specifying *M. faveolata* in particular.

3.8.2.6.5 Species-Specific Threats

This species information is assumed not to be materially different from boulder star coral; however, differences may be masked since many ecological studies collected data at the *M. annularis* complex level rather than specifying *M. faveolata* in particular.

NMFS evaluated the population's demographic, spatial structure, and vulnerability factors (Table 3.8-4) to determine whether the species was likely to have an "…extremely high risk of extinction with little chance for recovery…" by 2100 (Brainard et al. 2011). Elements that contribute to mountainous star coral's (*Montastraea faveolata*) proposed endangered status are: high vulnerability to ocean warming, disease, and ocean acidification; high vulnerability to sedimentation and nutrient over-enrichment; decreasing trend in abundance; low relative recruitment rate; moderate overall distribution (based on narrow geographic distribution and wide depth distribution); restriction to the Caribbean; and inadequacy of regulatory mechanisms.

3.8.2.7 Pillar Coral (*Dendrogyra cylindrus*)

3.8.2.7.1 Status and Management

In December 2012, NMFS issued a Proposed Rule for reef-building coral species including a proposed listing for pillar coral (*Dendrogyra cylindrus*) as endangered (FR *77*(236): 73219 – 73262, December 7, 2012). The proposed listing is based on a comprehensive status review (Brainard et al. 2011), a summary of management and conservation measures (National Oceanic and Atmospheric Administration 2012b), and a supplemental information report addressing new information and public comment to both status and management reports (National Oceanic and Atmospheric Administration 2012b). Additional information regarding this coral species, including the *Petition to List 83 Coral Species Under the ESA* by the Center for Biological Diversity (Sakashita and Wolf 2009), can be accessed at the website maintained by the NMFS Office of Protected Resources. Critical habitat has not yet been proposed for this species.

3.8.2.7.2 Habitat and Geographic Range

Pillar coral most frequently occurs at depths of 3–8 m, but has been documented at depths of 1–25 m (3.3–82.0 ft.) (Brainard et al. 2011; National Oceanic and Atmospheric Administration 2012b). It is known to occur in south Florida as far north as Broward County and from one colony in Bermuda, but is not known to occur at the Flower Garden Banks or elsewhere in the northern or western Gulf of Mexico.

Pillar coral range coincides with the Study Area in most areas that shallow-water coral reefs occur. The principal areas of coincidence between pillar coral habitat and the Study Area are near Puerto Rico and south Florida. Pillar coral is known to occur in portions of the South Florida Ocean Measurement Facility Testing Range (Gilliam and Walker 2011), adjacent to the Naval Air Station Key West, Key West Range Complex and the Puerto Rico/St. Croix Operating Area.

Southeast U.S. Continental Shelf, Caribbean Sea, and Gulf of Mexico Large Marine Ecosystems, and North Atlantic Gyre Open Ocean Area. Within the Study Area, pillar corals are typically found in the southern and southeastern parts of the Gulf of Mexico Large Marine Ecosystem, the northern part of the Caribbean Sea Large Marine Ecosystem, and the southern part of the Southeast U.S. Continental Shelf Large Marine Ecosystem. Pillar coral also occurs in the fragments of the North Atlantic Gyre Open Ocean Area that coincide with coral reef habitat.

3.8.2.7.3 Population and Abundance

Pillar coral is both rare and conspicuous. Because pillar coral colonies have been killed by warm and cold water bleaching, disease, and physical damage it has been assumed that this rare species is in decline. In general, pillar coral is too rare for meaningful trends in abundance to be detected by typical reef monitoring programs (Brainard et al. 2011).

Growth rates for this species are typically 8 millimeters (mm) per year, though rates up to 20 mm per year have been reported (Brainard et al. 2011). Pillar coral spawns, and the first-ever observations of this species reproducing were made at around 2100 hours, 3 to 4 days after the August full moon in 2012 (Miller 2012). Sexual reproduction is unlikely to be successful because the species is so rare and colonies are gonochoric (i.e., a colony is either male or female); male and female colonies are unlikely to be in close enough proximity for reliable fertilization. For this reason, no juveniles of pillar coral have been observed in the past several decades, and fragmentation seems to be the only successful mode of reproduction for this species (Brainard et al. 2011; National Oceanic and Atmospheric Administration 2012b).

3.8.2.7.4 Predator and Prey Interactions

Predators of this species seem to be few, and though the fireworm (*Hermodice carunculata*) feeds on pillar coral, it does not seem to be a major predator (Brainard et al. 2011). Pillar coral is distinctive among Caribbean corals because its tentacles are extended for feeding on zooplankton during the day, while most other corals' tentacles are retracted during the day (Boulon et al. 2005; Brainard et al. 2011). Pillar coral feeding strategies and symbioses are not materially different from elkhorn coral (Section 3.8.2.3, Elkhorn Coral).

3.8.2.7.5 Species-Specific Threats

Pillar coral has no species-specific threats. It is susceptible to the same suite of stressors that generally threaten corals (Section 3.8.2.15.1.5, Threats); however, it was historically more susceptible to exploitation by the curio trade (Brainard et al. 2011). Low population density is the principal threat to the species (Brainard et al. 2011; National Oceanic and Atmospheric Administration 2012b).

NMFS evaluated the population's demographic, spatial structure, and vulnerability factors (Table 3.8-4) to determine whether the species was likely to have an "…extremely high risk of extinction with little chance for recovery…" by 2100 (Brainard et al. 2011). Elements that contribute to pillar coral's proposed endangered status are: high vulnerability to disease, moderate vulnerability to ocean warming and acidification, rare general range-wide abundance, low relative recruitment rate, narrow overall distribution (based on narrow geographic distribution and moderate depth distribution), restriction to the Caribbean, and inadequacy of regulatory mechanisms.

3.8.2.8 Rough Cactus Coral (*Mycetophyllia ferox*)

3.8.2.8.1 Status and Management

In December 2012, NMFS issued a Proposed Rule for reef-building coral species including a proposed listing for rough cactus coral (*Mycetophyllia ferox*) as endangered under the ESA (FR 77(236): 73219 – 73262, December 7, 2012). The proposed listing is based on a comprehensive status review (Brainard et al. 2011), a summary of management and conservation measures (National Oceanic and Atmospheric Administration 2012b), and a supplemental information report addressing new information and public comment to both status and management reports (National Oceanic and Atmospheric Administration 2012b). Additional information regarding this coral species, including the *Petition to List 83 Coral Species Under the ESA* by the Center for Biological Diversity (Sakashita and Wolf 2009), can be accessed at the website maintained by the NMFS Office of Protected Resources. Critical habitat has not yet been proposed for this species.

The so-called common name is not commonly used for this species; when it is identified in literature and by enthusiasts it is almost invariably called by its scientific name.

3.8.2.8.2 Habitat and Geographic Range

Rough cactus coral is known to occur as deep as 80–90 m (Brainard et al. 2011; National Oceanic and Atmospheric Administration 2012b). Though reported to commonly occur at depths of 5–30 m (Aronson et al. 2008f), this could be an artifact of SCUBA diver-based survey intensity which decreases dramatically below 30 m. Rough cactus coral occurs in patch and fore reef habitat types, generally in lower energy parts of the reef (Brainard et al. 2011; National Oceanic and Atmospheric Administration 2012b). It is known from throughout the Caribbean and southern Gulf of Mexico, but is absent from the Flower Gardens Banks and Bermuda.

Rough cactus coral range coincides with the Study Area in most areas that shallow-water coral reefs occur. The principal areas of coincidence between rough cactus coral habitat and the Study Area are near Puerto Rico and south Florida. Rough cactus coral is known to occur in the South Florida Ocean Measurement Facility Testing Range (Gilliam and Walker 2011), adjacent to the Naval Air Station Key West, Key West Range Complex, and the Puerto Rico/St. Croix Operating Area.

Southeast U.S. Continental Shelf, Caribbean Sea, and Gulf of Mexico Large Marine Ecosystems, and North Atlantic Gyre Open Ocean Area. Within the Study Area, rough cactus coral is typically found in the southern and southeastern parts of the Gulf of Mexico Large Marine Ecosystem, the northern part of the Caribbean Sea Large Marine Ecosystem, and the southern part of the Southeast U.S. Continental Shelf Large Marine Ecosystem. Rough cactus coral also occurs in the fragments of the North Atlantic Gyre Open Ocean Area that coincide with coral reef habitat near Puerto Rico and the U.S. Virgin Islands (Brainard et al. 2011).

3.8.2.8.3 Population and Abundance

Though never particularly abundant, rough cactus coral in the Florida Keys has declined by at least 80 percent since 1996 and perhaps by much more since the 1970s (Brainard et al. 2011). Rough cactus coral was observed in a 2012 survey near Jobos Bay in southeast Puerto Rico, but it was not abundant enough to appear in a 65 m^2 (700 $ft.^2$) sample of reef habitat (Tetra Tech Inc. 2012).

Rough cactus coral is a hermaphroditic brooder, releasing approximately 100 fully-developed larvae per polyp in the late winter (February–March) (Szmant 1986; Trnka 2006). Recruitment rates are extremely low or absent (Brainard et al. 2011).

3.8.2.8.4 Predator and Prey Interactions

Rough cactus coral is not known to be susceptible to predators (Brainard et al. 2011), and feeding strategies and symbioses are not materially different from elkhorn coral (Section 3.8.2.3, Elkhorn Coral).

3.8.2.8.5 Species-Specific Threats

Though not especially susceptible to mortality from warm-water bleaching (Brainard et al. 2011; van Oppen and Lough 2009), 15 percent of *Mycetophyllia* species were killed after the cold-water bleaching event in Florida (Lirman et al. 2011). Some coral diseases are characterized by the white-colored bands or pox they cause, but are otherwise difficult to discriminate (Porter et al. 2001). While diseases such as 'white plague' do not seem to be species-specific (Porter et al. 2001), rough cactus coral in the Florida Keys has been particularly susceptible to 'white plague' (Brainard et al. 2011).

NMFS evaluated the population's demographic, spatial structure, and vulnerability factors (Table 3.8-4) to determine whether the species was likely to have an "…extremely high risk of extinction with little chance for recovery…" by 2100 (Brainard et al. 2011). Elements that contribute to rough cactus coral's (*Mycetophyllia ferox*) proposed endangered status are: high vulnerability to disease; moderate vulnerability to ocean warming and acidification; high vulnerability to nutrient over-enrichment; rare general range-wide abundance; decreasing trend in abundance; low relative recruitment rate; moderate overall distribution (based on narrow geographic distribution and wide depth distribution); restriction to the Caribbean; and inadequacy of regulatory mechanisms.

3.8.2.9 Star Coral (*Montastraea franksi*)

3.8.2.9.1 Status and Management

In December 2012, NMFS issued a Proposed Rule for reef-building coral species including a proposed listing for star coral (*Montastraea franksi*) as endangered under the ESA (FR *77*(236): 73219 – 73262, December 7, 2012). The proposed listing is based on a comprehensive status review (Brainard et al. 2011), a summary of management and conservation measures (National Oceanic and Atmospheric Administration 2012b), and a supplemental information report addressing new information and public comment to both status and management reports (National Oceanic and Atmospheric Administration 2012b). Additional information regarding this coral species, including the *Petition to List 83 Coral Species Under the ESA* by the Center for Biological Diversity (Sakashita and Wolf 2009), can be accessed at the website maintained by the NMFS Office of Protected Resources. Critical habitat has not yet been proposed for this species.

The so-called common name is not commonly used for this species; when it is identified in literature and by enthusiasts it is almost invariably called by its scientific name.

3.8.2.9.2 Habitat and Geographic Range

Star coral is found at least as deep as 50 m (164 ft.), and is found in most reef environments. The *M. annularis* complex has been reported to at least 70–90 m (230–295 ft.), though only *M. faveolata* and

M. franksi are likely to occur at these depths. The species is found in Bermuda but otherwise its geographic range is not materially different from *M. annularis*.

Star coral is known to occur in the South Florida Ocean Measurement Facility Testing Range (Gilliam and Walker 2011), adjacent to Naval Air Station Key West, Key West and Gulf of Mexico Range Complexes, and the Puerto Rico/St. Croix Operating Area. However, some of this geographic range information is based on ecological studies that identified the *M. annularis* complex rather than specifying *M. franksi* in particular.

3.8.2.9.3 Population and Abundance

This species information is assumed not to be materially different from boulder star coral; however, differences may be masked since many ecological studies collected data at the *M. annularis* complex level rather than specifying *M. franksi* in particular.

3.8.2.9.4 Predator and Prey Interactions

This species information is assumed not to be materially different from boulder star coral; however, differences may be masked since many ecological studies collected data at the *M. annularis* complex level rather than specifying *M. franksi* in particular.

3.8.2.9.5 Species-Specific Threats

Star coral was less susceptible to mortality after the 2010 cold-water bleaching event in Florida than any of its congeners by at least a factor of three (Lirman et al. 2011). Otherwise, susceptibility to threats is not assumed to be materially different from boulder star coral; however, differences may be masked because many ecological studies identified the *M. annularis* complex rather than specifying *M. franksi* in particular.

NMFS evaluated the population's demographic, spatial structure, and vulnerability factors (Table 3.8-4) to determine whether the species was likely to have an "…extremely high risk of extinction with little chance for recovery…" by 2100 (Brainard et al. 2011). Elements that contribute to star coral's proposed endangered status are: high vulnerability to ocean warming disease, and ocean acidification; high vulnerability to sedimentation and nutrient over-enrichment; decreasing trend in abundance; low relative recruitment rate; moderate overall distribution (based on narrow geographic distribution and wide depth distribution); restriction to the Caribbean; and inadequacy of regulatory mechanisms.

3.8.2.10 Elliptical Star Coral (*Dichocoenia stokesii*)

3.8.2.10.1 Status and Management

In December 2012, NMFS issued a Proposed Rule for reef-building coral species including a proposed listing for elliptical star coral as threatened under the ESA (FR *77*(236): 73219 – 73262, December 7, 2012). The proposed listing is based on a comprehensive status review (Brainard et al. 2011), a summary of management and conservation measures (National Oceanic and Atmospheric Administration 2012b), and a supplemental information report addressing new information and public comment to both status and management reports (National Oceanic and Atmospheric Administration 2012b). Additional information regarding this coral species, including the *Petition to List 83 Coral Species Under the ESA* by the Center for Biological Diversity (Sakashita and Wolf 2009), can be accessed at the website maintained by the NMFS Office of Protected Resources. Critical habitat has not yet been proposed for this species.

The so-called common name is not commonly used for this species; when it is identified in literature and by enthusiasts it is almost invariably called by its scientific name.

The taxonomic status of this species is a matter of discussion among coral taxonomists. The supplementary information report cites a prominent coral taxonomist's comment that *Dichocoenia stokesii* and *Dichocoenia stellaris* fit the criterion of a single species rather than two separate species. Thus far, the NMFS review and listing process considers these two to be separate species (National Oceanic and Atmospheric Administration 2012b). Further, there is disagreement about whether the species name is spelled as *D. stokesi* or *D. stokesii*. The revised, current, name according to the Integrated Taxonomic Information System is *D. stokesii* (Integrated Taxonomic Information System 2012).

3.8.2.10.2 Habitat and Geographic Range

Elliptical star coral (*Dichocoenia stokesii*) has a broad depth distribution; it is found from 7 to 236 ft. (2 to 72 m) on rocky reefs, back reefs, and fore reefs (Aronson et al. 2008d; Brainard et al. 2011). It is known to occur throughout the Caribbean, Bahamas, the Flower Garden Banks, the eastern Gulf of Mexico, and Bermuda.

Elliptical star coral range coincides with the Study Area in most areas that shallow-water coral reefs occur. The principal areas of coincidence between elliptical star coral habitat and the Study Area are near Puerto Rico and south Florida. Elliptical star coral is known to occur in the South Florida Ocean Measurement Facility Testing Range (Gilliam and Walker 2011), adjacent to Naval Air Station Key West, Key West and Gulf of Mexico Range Complexes, and the Puerto Rico/St. Croix Operating Area.

Southeast U.S. Continental Shelf, Caribbean Sea, and Gulf of Mexico Large Marine Ecosystems, and North Atlantic Gyre Open Ocean Area. Within the Study Area, elliptical star coral is typically found in the northern, southern, southeastern, and eastern parts of the Gulf of Mexico Large Marine Ecosystem, the northern part of the Caribbean Sea Large Marine Ecosystem, and the southern part of the Southeast U.S. Continental Shelf Large Marine Ecosystem. Elliptical star coral also occurs in the fragments of the North Atlantic Gyre Open Ocean Area that coincide with coral reef habitat near Puerto Rico and the U.S. Virgin Islands (Aronson et al. 2008c, e).

3.8.2.10.3 Population and Abundance

Elliptical star coral is usually uncommon although on reefs in south Florida it is the ninth most abundant coral species (Brainard et al. 2011). Elliptical star coral was observed in a 2012 survey near Jobos Bay in southeast Puerto Rico that recorded four colonies in a 65 m^2 (700 $ft.^2$) sample of reef habitat (Tetra Tech Inc. 2012).

Reproduction occurs most frequently by broadcast spawning in August–September and October. Most colonies of elliptical star coral are gonochoric (i.e., a colony is either male or female), but approximately one-fifth are hermaphroditic. Average egg size is about 0.3 mm and females produce about 1,000 eggs per square cm per year (cm^2/yr.) (Brainard et al. 2011). Recruitment rates are relatively high, ranging from 0.1 to 1 juvenile per m^2 (11 $ft.^2$) in certain habitats, but survival to reproductive size (160 cm^2 [25 $in.^2$]) remains relatively low (Brainard et al. 2011).

3.8.2.10.4 Predator and Prey Interactions

Although elliptical star coral is minimally affected by predators, commensal and parasitic organisms such as bioeroding sponges and bivalves affect many colonies (Aronson et al. 2008d; Brainard et al. 2011).

Feeding strategies and symbioses are not materially different from elkhorn coral (Section 3.8.2.3, Elkhorn Coral).

3.8.2.10.5 Species-Specific Threats

Elliptical star coral has no known species-specific threats. It is susceptible to the same suite of stressors that generally threaten corals (Section 3.8.2.15.1.5, Threats). Although it is relatively resilient to most of these threats, elliptical star coral is particularly susceptible to white plague type II, which decimated the population in southern Florida (Aronson et al. 2008d; Brainard et al. 2011).

NMFS evaluated the population's demographic, spatial structure, and vulnerability factors (Table 3.8-4) to determine whether the species was likely to have an "…extremely high risk of extinction with little chance for recovery…" by 2100 (Brainard et al. 2011). Elements that contribute to elliptical star coral's *(Dichocoenia stokesii*) proposed threatened status are: high vulnerability to disease, moderate vulnerability to ocean warming and acidification, moderate overall distribution (based on narrow geographic distribution and wide depth distribution), restriction to the Caribbean, and inadequacy of regulatory mechanisms.

3.8.2.11 Lamarck's Sheet Coral (*Agaricia lamarcki*)

3.8.2.11.1 Status and Management

In December 2012, NMFS issued a Proposed Rule for reef-building coral species including a proposed listing for Lamarck's sheet coral (*Agaricia lamarcki*) as threatened under the ESA (FR *77*(236): 73219 – 73262, December 7, 2012). The proposed listing is based on a comprehensive status review (Brainard et al. 2011), a summary of management and conservation measures (National Oceanic and Atmospheric Administration 2012b), and a supplemental information report addressing new information and public comment to both status and management reports (National Oceanic and Atmospheric Administration 2012b). Additional information regarding this coral species, including the *Petition to List 83 Coral Species Under the ESA* by the Center for Biological Diversity (Sakashita and Wolf 2009), can be accessed at the website maintained by the NMFS Office of Protected Resources. Critical habitat has not yet been proposed for this species.

The so-called common name is not commonly used for this species; when it is identified in literature and by enthusiasts it is almost invariably called by its scientific name.

3.8.2.11.2 Habitat and Geographic Range

Lamarck's sheet coral is found across a very wide depth range from 3 to 100 m (9.8 to 328.1 ft.) and its frequency seems to increase with depth, particularly from 50 to 100 m (164.0 to 328.1 ft.). In shallower waters it is frequently found in shaded areas of the fore reef (Brainard et al. 2011; National Oceanic and Atmospheric Administration 2012b). It is known to occur throughout the Caribbean, Bahamas, and the Flower Garden Banks, but is absent from Bermuda.

Lamarck's sheet coral range coincides with the Study Area in most areas that shallow-water coral reefs occur. The principal areas of coincidence between Lamarck's sheet coral habitat and the Study Area are near Puerto Rico and south Florida. Lamarck's sheet coral is known to occur in the South Florida Ocean Measurement Facility Testing Range (Gilliam and Walker 2011), adjacent to the Naval Air Station Key West, Key West, and Gulf of Mexico Range Complexes, and the Puerto Rico/St. Croix Operating Area.

Southeast U.S. Continental Shelf, Caribbean Sea, and Gulf of Mexico Large Marine Ecosystems, and North Atlantic Gyre Open Ocean Area. Within the Study Area, Lamarck's sheet coral is typically found in the southern and southeastern parts of the Gulf of Mexico Large Marine Ecosystem, the northern part of the Caribbean Sea Large Marine Ecosystem, and the southern part of the Southeast U.S. Continental Shelf Large Marine Ecosystem. Lamarck's sheet coral also occurs in the fragments of the North Atlantic Gyre Open Ocean Area that coincide with coral reef habitat near Puerto Rico and the U.S. Virgin Islands.

3.8.2.11.3 Population and Abundance

Though never particularly abundant, Lamarck's sheet coral is occasionally common and trends in abundance are not well established (Brainard et al. 2011). Lamarck's sheet coral was observed in a 2012 survey near Jobos Bay in southeast Puerto Rico that recorded five colonies in a 65 m^2 (700 $ft.^2$) sample of reef habitat (Tetra Tech Inc. 2012).

Reproduction is not known directly from Lamarck's sheet coral, but its congeners are brooders and release fully-formed larvae throughout the year with peaks at night time and in May (Brainard et al. 2011; Trnka 2006). Recruitment rates are exceptionally low and growth is slow. Average growth rate is 5 mm per year at depths shallower than 20 m (65.6 ft.), and growth rates decline substantially as depth increases (Brainard et al. 2011).

3.8.2.11.4 Predator and Prey Interactions

Predation on Lamarck's sheet coral is unknown (Brainard et al. 2011), and feeding strategies and symbioses are not materially different from elkhorn coral (Section 3.8.2.3, Elkhorn Coral).

3.8.2.11.5 Species-Specific Threats

Lamarck's sheet coral has no known species-specific threats. It is susceptible to the same suite of stressors that generally threaten corals (Section 3.8.2.15.1.5, Threats), however it was historically more susceptible to take by the curio trade (Brainard et al. 2011). Lamarck's sheet coral is not particularly susceptible to mortality from warm-water bleaching, or from cold-water bleaching following Florida's catastrophic cold-water bleaching event of 2010 (Brainard et al. 2011; Lirman et al. 2011).

NMFS evaluated the population's demographic, spatial structure, and vulnerability factors (Table 3.8-4) to determine whether the species was likely to have an "…extremely high risk of extinction with little chance for recovery…" by 2100 (Brainard et al. 2011). Elements that contribute to Lamarck's sheet coral's (*Agaricia lamarcki*) proposed threatened status are: moderate vulnerability to ocean warming, disease, and acidification; low relative recruitment rate; moderate overall distribution (based on narrow geographic distribution and wide depth distribution); restriction to the Caribbean; and inadequacy of regulatory mechanisms.

3.8.2.12 Queen Conch (*Lobatus gigas*)

The scientific name for the queen conch was recently changed from *Strombus gigas* to *Lobatus gigas* based on taxonomic research published in the last decade, and accepted by the World Register of Marine Species in March 2011 (Bouchet 2012). *Lobatus gigas* includes seven synonymous species formerly considered to be distinct. The former name of *Strombus gigas*, rather than the valid name *Lobatus gigas*, is used in the petition to list queen conch under the ESA, the NMFS 90-day finding, and in most regulations to-date. It is likely that future documentation will use the new name *Lobatus gigas*, while referencing *Strombus gigas* and the other synonymous species.

3.8.2.12.1 Status and Management

In February 2012, NMFS received a petition to list the queen conch as threatened or endangered under the ESA and to designate critical habitat concurrently with the listing (FR *77*(166): 51763-51767, August 27, 2012). In its 90-day review, NMFS concluded that substantial scientific information may warrant listing under the ESA, and a status review for the queen conch is currently underway (FR *77*(166): 51763-51767, August 27, 2012).

Queen conch have a long history of harvest by commercial and recreational fisheries in Florida, Puerto Rico, and throughout the Caribbean. Living exclusively in shallow nearshore waters, queen conch are readily harvested by swimmers and divers. All conch fishing in Florida and adjacent federal waters has been closed since 1986 (Florida Fish and Wildlife Conservation Commission 2006; National Oceanic and Atmospheric Administration 2012a). Commercial and recreational fisheries for queen conch are open in Puerto Rico, the U.S. Virgin Islands, and adjacent federal waters; with restrictions managed by the Caribbean Fisheries Management Council (FR 70(176): 53979-54004, September 13, 2005). The majority of landings by the U.S. queen conch fishery (86 percent) are reported from state rather than federal waters (FR 70(176): 53979-54004, September 13, 2005).

3.8.2.12.2 Habitat and Geographic Range

The queen conch is typically found in nearshore tropical and subtropical sand, algae, seagrass, and coral rubble habitats from the intertidal zone to approximately 70 ft. (21 m) (National Oceanic and Atmospheric Administration 2012a), though they are occasionally found in rocky and reef habitats to at least 300 ft. (100 m) (WildEarth Guardians 2012). Queen conch are associated with subtidal sand flats, and are not associated with high-energy sandy beaches. In some circumstances, queen conch will migrate to sheltered shallow water to reproduce. These snails travel relatively short distances as juveniles and adults, but their planktonic larvae can travel great distances in the 2–8 weeks between hatching and settlement (WildEarth Guardians 2012).

The geographic range of the queen conch centers on the Caribbean; it extends northward to northern Florida and Bermuda, south to the Amazon River delta, and west throughout the Gulf of Mexico (WildEarth Guardians 2012). Because queen conch are typically found in shallow nearshore waters, relatively little of their range coincides with the Study Area. The principal areas of coincidence between queen conch habitat and the Study Area are near Puerto Rico and south Florida. Portions of the Naval Surface Warfare Center, Panama City Division Testing Range; South Florida Ocean Measurement Facility Testing Range; and the JAX, Key West, and GOMEX Range Complexes overlap with queen conch habitat.

Southeast U.S. Continental Shelf Large Marine Ecosystem. The queen conch's range includes suitable shallow nearshore habitat in Florida, particularly the Florida Keys (WildEarth Guardians 2012).

Gulf of Mexico Large Marine Ecosystem. The queen conch's range includes suitable shallow nearshore habitat throughout the Gulf of Mexico, though it is most common in the Florida Keys and the Yucatan Peninsula (WildEarth Guardians 2012).

Caribbean Sea Large Marine Ecosystem. This large marine ecosystem coincides with the center of the queen conch's range. The species can be found in suitable, shallow, nearshore habitat throughout this large marine ecosystem.

North Atlantic Gyre Open Ocean Area. Queen conch are found only in Bermuda and in the southwestern-most portions of this open ocean area, primarily in suitable, shallow, nearshore habitat adjacent to Puerto Rico, the U.S. Virgin Islands, and the Bahamas.

3.8.2.12.3 Population and Abundance

Queen conch are reproductively mature at approximately 4 years and have a typical lifespan of 20–30 years (Florida Fish and Wildlife Conservation Commission 2006; Stoner and Ray-Culp 2000). Spawning occurs from May to October, peaking in the summer. Under ideal conditions a female can lay up to nine egg masses in a season, each with hundreds of thousands of eggs (Stoner and Ray-Culp 2000; WildEarth Guardians 2012). They hatch after 3–5 days and settle into sheltered seagrass beds and sand flats after 2–8 weeks as planktonic larvae.

The lack of viable fisheries throughout most of the Caribbean is cited as an indicator for severely depleted populations (National Oceanic and Atmospheric Administration 2012a; WildEarth Guardians 2012). The abundance of queen conch, primarily inferred from fisheries landings, declined through the 1970s. The commercial fishery in the Florida Keys was closed in 1975 after the population collapsed, and similar population and fishery collapses occurred in much of the Caribbean through the 1990s. The population of adult queen conch in the Florida Keys is estimated to be 50,000 or fewer (Florida Fish and Wildlife Conservation Commission 2006; Stoner et al. 1996). Population declines are particularly concerning for slow-moving queen conch because their reproductive success is linked to the density of potential mates in a relatively small area. Recovery is less likely where populations are depleted because fewer successful matings occur. With fewer than approximately 50 adults per hectare (ha) (approximately 20 per acre [ac.]), queen conch are unlikely to find a mate in a spawning season (Stoner and Ray-Culp 2000). Where populations fall below this threshold, recovery is essentially impossible and extinction or extirpation becomes very likely (Gascoigne et al. 2009). Queen conch populations in portions of the U.S. Virgin Islands (e.g., St. Croix) were recently estimated to be 44 adults per ha (approximately 18 per ac.) (Rothenberger et al. 2008). Two recent large-scale surveys of inshore and nearshore waters of Jobos Bay, in southeastern Puerto Rico, found between 0 and 1 adult per ha (approximately 0.4 per ac.) (Tetra Tech Inc. 2012; Whitall et al. 2011).

3.8.2.12.4 Predator and Prey Interactions

Queen conch are primarily herbivorous, feeding on detritus, macroalgae, and small plants typically attached to seagrass blades (generally called epiphytes). They do not usually eat the seagrass itself (WildEarth Guardians 2012).

Queen conch are susceptible to a variety of invertebrate and vertebrate predators, particularly as planktonic larvae and juveniles (Iversen et al. 1986; WildEarth Guardians 2012). Notable among these predators are rays, nurse sharks, loggerhead turtles, and several species of snails, crabs, and lobsters (Iversen et al. 1986). Their susceptibility to predators decreases with age as their size and shell thickness increases (WildEarth Guardians 2012).

3.8.2.12.5 Species-Specific Threats

The principal species-specific threat to queen conch is fishing. The United States consumes approximately 78 percent of all conch meat taken from the Caribbean (National Oceanic and Atmospheric Administration 2012a; WildEarth Guardians 2012). Water pollution—particularly the heavy metals copper and zinc—interferes with queen conch reproduction (Spade et al. 2010). When adult conch are translocated out of polluted habitats, they become capable of reproduction within 6 months (Delgado et al. 2004).

3.8.2.13 Foraminiferans, Radiolarians, Ciliates (Kingdom Protozoa)

Foraminiferans, radiolarians, and ciliates are small singled-celled organisms (sometimes forming colonies of cells) belonging to kingdom Protozoa (Appeltans et al. 2010). Classification schemes for Protozoa change frequently, and foraminiferans, radiolarians, and ciliates are members of three phyla that represent some of the conventional protozoan groupings. They are found in the water column and seafloor of the world's oceans (Table 3.8-3), and while most are microscopic, some species grow to approximately 4 in. (10 cm). Foraminiferans (phylum Foraminifera), such as those in the genus *Globigerina*, form diverse and intricate shells out of calcium carbonate (University of California Berkeley 2010c). Shells of foraminiferans that live in the water column eventually sink to the deep seafloor forming sediments known as foraminiferal ooze. Planktonic and benthic foraminifera shells form substantial deposits of carbonate sediment. Peculiar types of foraminifera are xenophyophores that have complex habitat-forming structures similar to sponges (Buhl-Mortensen et al. 2010). Individual xenophyophores are sometimes larger than 5 in. (10 cm) and occur throughout the oceans in waters deeper than 1,600 ft. (500 m). Foraminiferans feed on diatoms and other small organisms, and some form symbioses with algae similar to coral-algae symbiosis (Cockey et al. 1996). Their predators include copepods and other zooplankton, echinoderms, and some fish. Radiolarians (phylum Sarcodina) are microscopic organisms that form glass-like shells made of silica. Radiolarian ooze covers large areas of the ocean floor (Pearse 1987; University of California Berkeley 2010f). Ciliates (phylum Ciliophora) are protozoans with small hair-like structures called cilia used to feed and move around. They are a critical food source for primary consumers and are considered important parasites of many marine invertebrates.

3.8.2.14 Sponges (Phylum Porifera)

Sponges include approximately 8,550 marine species worldwide and are classified in the phylum Porifera (Appeltans et al. 2010; Van Soest et al. 2012). Sponges are bottom-dwelling, multicellular animals that can be best described as an aggregation of cells that perform different functions. Sponges are largely sessile (not mobile), except for their larval stages, and are common throughout the Study Area at all depths. Sponges reproduce both sexually and asexually. Water flow through the sponge provides food, oxygen, and removes wastes (Castro and Huber 2000; Pearse 1987; University of California Berkeley 2010e). Most sponges form calcium carbonate or silica structures embedded in cells to provide structural support (Castro and Huber 2000; Van Soest et al. 2012). Sponges provide homes for a huge variety of animals including shrimp, crabs, barnacles, worms, brittle stars, holothurians (e.g., sea cucumber), and other sponges (Colin and Arneson 1995d). Within the western Atlantic coral reefs and related ecosystems there are 117 genera of sponges (Spalding et al. 2001). Some species are commercially harvested in Florida waters located in the Gulf of Mexico Large Marine Ecosystem, including the sheepswool sponge (*Hippiospongia lachne*) and yellow sponge (*Cleona celata*) (Stevely and Sweat 2008).

3.8.2.14.1 Reef-Forming Sponges

Reef-forming sponges are found in the Study Area, particularly in the canyons of the Northeast U.S. Continental Shelf Large Marine Ecosystem (Leys et al. 2007; Whitney et al. 2005). Some sponge reefs are protected as part of Essential Fish Habitat for federally managed species and their value as providers of important habitat is being intensively studied (Buhl-Mortensen et al. 2010; National Oceanic and Atmospheric Administration and U.S. Department of Commerce 2010). Although most sponges do not form reefs because their skeletons do not persist intact after the colony's death, they are long-lived and form important habitat while they are alive.

Reef-forming sponges are known throughout the Study Area, but knowledge of their distribution and abundance is incomplete. Some areas of the Northeast U.S. Continental Shelf Large Marine Ecosystem are known to contain sponge reefs at depths of 1,000 to 1,300 m (Whitney et al. 2005), and the Gulf of Mexico Large Marine Ecosystem is being intensively explored (National Oceanic and Atmospheric Administration and U.S. Department of Commerce 2010). Reef-building sponges are filter-feeders, and animals that prey upon them are poorly known; however, using shallow water sponges as analogues, reef-forming sponges would be preyed upon by relatively few animals. The only known threats to reef-building sponges are physical strike and disturbance from anthropogenic activities (Whitney et al. 2005).

3.8.2.15 Corals, Hydroids, Jellyfish (Phylum Cnidaria)

There are more than 10,000 marine species of corals, hydroids, and jellyfish worldwide (Appeltans et al. 2010). Members of this group are found throughout the Study Area at all depths. Hydroids are colonial animals similar in form to corals. Hydroids have both flexible and rigid skeletons, and most with flexible skeletons are not considered to be reef-forming (Colin and Arneson 1995a; Gulko 1998). Jellyfish are motile as larvae, sessile as an intermediate colonial polyp stage, and motile as adults (Brusca and Brusca 2003). They are predatory at all stages and, like all cnidarians, use tentacles equipped with stinging cells to capture prey (Castro and Huber 2000; University of California Berkeley 2010b). Despite a strong popular perception that jellyfish populations are increasing in the wake of anthropogenic stressors, there is active scientific discourse about whether the apparent increase is genuine (Brotz et al. 2012), unsubstantiated (Condon et al. 2012), or equivocal (Purcell 2012). Jellyfish are an important prey species to a range of organisms, including some sea turtles and some ocean sunfish (*Mola* spp.) (Heithaus et al. 2002; James and Herman 2001).

Corals are in a class of animals that also includes anemones and soft corals. All sessile cnidarians are habitat-forming. The individual unit is referred to as a polyp, and most species occur as colonies of polyps. Reef-building corals fall into two primary zones: the shallow (photic) and deep (aphotic). Reef-building hard corals (sometimes called stony corals) in shallow water generally occur only in the warm waters bounded by the Tropics of Cancer and Capricorn (latitudinal lines), while deep-water hard and soft corals have a worldwide distribution including all large marine ecosystems in the Study Area (Freiwald et al. 2004; Sheppard et al. 2009; Spalding et al. 2001; Watling et al. 2011). Reef-building corals in the photic zone usually host symbiotic algae called zooxanthellae that provide extra energy to the corals (Castro and Huber 2000). The photic zone is defined by the limit of light penetration and the photic-aphotic transition occurs around 200 m in the open ocean, but varies with water clarity (see U.S. Department of the Navy 2012). All corals feed on small planktonic organisms or dissolved organic matter, although some shallow-water corals derive most of their energy from their symbiotic algae (Dubinsky and Berman-Frank 2001). Most hard corals and some soft corals are reef-forming (i.e., they form coral reefs) (Freiwald et al. 2004; Spalding et al. 2001; Watling et al. 2011), and some soft corals define particular habitat types (e.g., hard bottom is typically characterized by sponges and soft corals) (South Atlantic Fishery Management Council 1998a). The habitat-forming and reef-forming attributes of corals are particularly important to this EIS/OEIS and are discussed in terms of shallow-water corals, hard bottom, and deep-water corals.

3.8.2.15.1 Shallow-Water Corals

3.8.2.15.1.1 Status and Management

Coral reefs are constructed by complexes of corals and other plants and animals that build limestone skeletons or leave calcium carbonate debris as a result of their growth. The cumulative result is a three-dimensional irregular structure that is unique compared to the surrounding seascape (South Atlantic Fishery Management Council 1998a). Shallow-water coral reefs are protected by Executive Order 13089, *Coral Reef Protection*, and managed by the Coral Reef Task Force *(*FR *63*(115) 32701-32703, June 16, 1998). The aim of the U.S. Coral Reef Task Force is to protect and preserve coral reefs (FR 63(115) 32701-32703, June 16, 1998). Its efforts include research and the implementation of strategies to overcome coral decline, the reduction of reef pollution, and overfishing. The Navy is the Department of Defense (DoD) representative to the U.S. Coral Reef Task Force and also carries out the Coral Reef Protection Implementation Plan. This plan provides information for DoD agencies on the protection and conservation of coral reefs (Lobel and Lobel 2000).

These reefs are managed both as fisheries and as Essential Fish Habitat or Habitat of Particular Concern (Caribbean Fishery Management Council 1994; Gulf of Mexico Fishery Management Council 2005; South Atlantic Fishery Management Council 1998a) (Figures 3.8-2 and 3.8-3). Also, the two species of coral listed as threatened and the seven species proposed for listing under the ESA inhabit shallow water areas, and much of the shallow-water coral reef habitat in the Study Area is designated critical habitat for these species (Sections 3.8.2.3, Elkhorn Coral [*Acropora palmata*], and 3.8.2.4, Staghorn Coral [*Acropora cervicornis*]).

3.8.2.15.1.2 Geographic Range

In the Study Area, shallow-water coral reefs occur in the southern part of the Gulf of Mexico Large Marine Ecosystem, throughout the Caribbean Sea Large Marine Ecosystem, and in the southern part of the Southeast U.S. Continental Shelf Large Marine Ecosystem, including southeast Florida and the Bahamas (Spalding et al. 2001). See Figures 3.3-1 to 3.3-4 for a map of hard coral habitat in the Study Area.

In the central and eastern part of the Gulf of Mexico Large Marine Ecosystem, coral reefs occur in Flower Gardens Banks National Marine Sanctuary, Pulley Ridge Ecological Reserve, Dry Tortugas Ecological Reserve, and Florida Keys (Monaco et al. 2008; Spalding et al. 2001; United States Geological Survey 2010). In the Southeast U.S. Continental Shelf Large Marine Ecosystem, shallow-water coral reefs occur throughout the Florida Keys and southeast Florida and total, conservatively, between 250 and 364 nm^2 (Burke and Maidens 2004). Reefs also occur in the Caribbean Sea Large Marine Ecosystem surrounding Puerto Rico and the U.S. Virgin Islands. All these areas are managed as habitat areas of particular concern, as identified in Figures 3.8-2 and 3.8-3.

Although the shallow waters of Bermuda are outside the Study Area, they represent an important part of the coral reefs in the North Atlantic Gyre Open Ocean Area and cover an area of 410 nm^2 (Spalding et al. 2001). The islands of the Bahamas have patch reefs and one of the longest reefs in the western Atlantic (Andros Reef) (Spalding et al. 2001). Andros Reef is east of Andros Island in the northern part of the Caribbean Sea Large Marine Ecosystem.

Coral reefs cover approximately 380 nm^2 of the seafloor surrounding Puerto Rico within 3 nm of the coastline (Causey et al. 2002). Fringing reefs are the most common type of reef. Culebra and Vieques islands are nearly surrounded by reefs. The islands of St. Croix, St. John, and St. Thomas of the U.S. Virgin Islands have fringing reefs, patch reefs, and spur and groove reefs. St. Croix also has barrier reefs (Causey et al. 2002). A survey that included depths to 66 ft. (20 m) found approximately 86 nm^2 of coral reef and hard bottom habitat (Causey et al. 2002).

3.8.2.15.1.3 Abundance

The coral reefs of the Florida Keys, Flower Garden Banks National Marine Sanctuary, Puerto Rico, and Bermuda host approximately 64, 21, 117, and 22 species of hard coral, respectively (Causey et al. 2002; Creary et al. 2008). Several of the most important Caribbean coral species are now listed, or are proposed for listing under the ESA (Sections 3.8.2.3, Elkhorn Coral [*Acropora palmata*] to Section 11 Lamarck's Sheet Coral [*Agaricia lamarcki*]). The number of coral species is often somewhat uncertain because coral taxonomy is updated every few years. Coral reefs in the Study Area are described as among the most degraded in the world (Bryant et al. 1998; Pandolfi et al. 2005). For further discussion of threats, Section 3.8.2.2 General Threats.

3.8.2.15.1.4 Predator-Prey Interactions

Predators of corals include sea stars, snails, and fishes (e.g., the predatory snail, *Coralliophila abbreviata*; the fireworm, *Hermodice carunculata*; and damselfish) (Boulon et al. 2005; Gochfeld 2004; Grober-Dunsmore et al. 2006; Gulko 1998).

Corals prey on zooplankton, which are small organisms that inhabit the ocean. Corals capture prey with tentacles armed with stinging cells that surround the mouth or by employing a mucus-net to catch suspended prey (Brusca and Brusca 2003). In addition to capturing prey, corals possess another method of acquiring essential nutrients through their relationship with zooxanthellae that benefits both organisms. The coral host provides nitrogen in the form of waste to the zooxanthellae, and the zooxanthellae provide organic compounds produced by photosynthesis to its host (Brusca and Brusca 2003; Schuhmacher and Zibrowius 1985). Some corals derive most of their energy from their zooxanthellae symbionts, resulting in dramatically reduced need for the coral to feed on zooplankton (Lough and Van Oppen 2009). Zooxanthellae also provide corals with most of their characteristic color.

3.8.2.15.1.5 Threats

There are very few species-specific threats for a particular coral species, though many threats have proportionally greater impact to particular groups, genera, or families of coral. For example, a type of "white" disease in the Caribbean preferentially infects colonies of the genus *Acropora* (Porter et al. 2001). Some groups of corals are more or less susceptible to predation and general threats. For example a predatory snail (*Coralliophila abbreviata*) feeds preferentially, but not exclusively, on *Acropora* species (Grober-Dunsmore et al. 2006). The aquarium industry has various taxa-specific preferences (Sakashita and Wolf 2009).

As key habitat-forming invertebrates (see U.S. Department of the Navy 2012), the threats to corals and coral reefs are well-studied. Factors that can stress or damage coral reefs are coastal development (Field et al. 2008; Risk 2009), impacts from inland pollution and erosion (Cortes and Risk 1985; Downs et al. 2011), coastal runoff (Downs et al. 2009; Downs et al. 2011), overexploitation and destructive fishing practices (Jackson et al. 2001; Pandolfi et al. 2003), global climate change and acidification (Doney et al. 2012; Doropoulos et al. 2012; Hughes et al. 2003), disease (Lesser et al. 2007; Porter et al. 2001), predation (Hayes 1990), harvesting by the aquarium trade (Caribbean Fishery Management Council 1994), vessel anchors (Burke and Maidens 2004), invasive species (Bryant et al. 1998; Galloway et al. 2009; Wilkinson 2002), ship groundings (National Oceanic and Atmospheric Administration 2010c), oil spills (National Oceanic and Atmospheric Administration 2001), and possibly human-made noise (Vermeij et al. 2010). Coral growth rates are reduced because of a

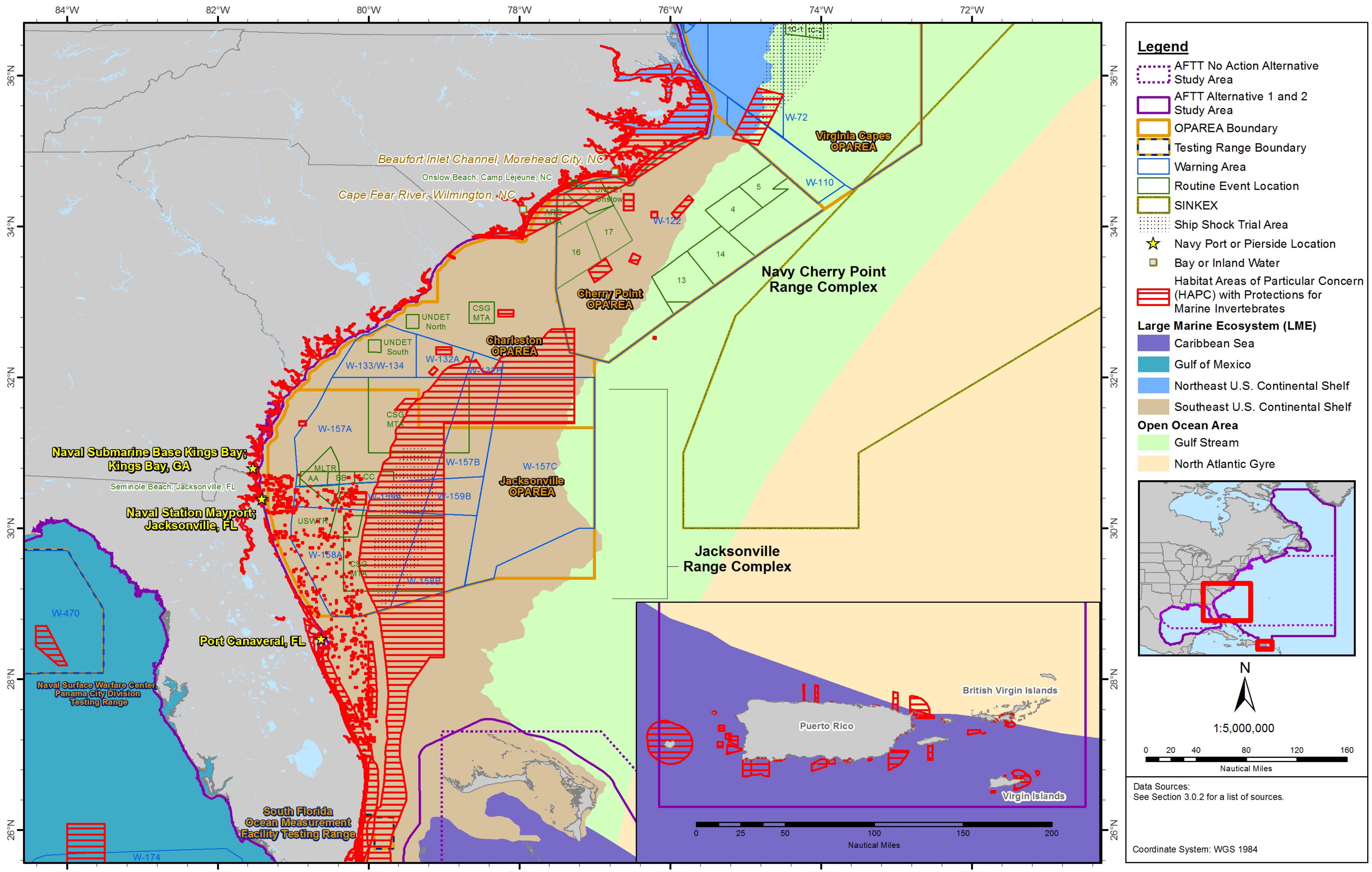

Figure 3.8-2: Habitat Areas of Particular Concern within the Southeastern Portion of the Study Area

AFTT: Atlantic Fleet Training and Testing; ARG MTA: Amphibious Readiness Group Mine Training Area; CSG MTA: Carrier Strike Group Mine Training Area; FL: Florida; GA: Georgia; MLTR: Missile Laser Training Range; NC: North Carolina; OPAREA: Operating Area; SINKEX: Sinking Exercise Box; UNDET: Underwater Detonation; USWTR: Undersea Warfare Training Range

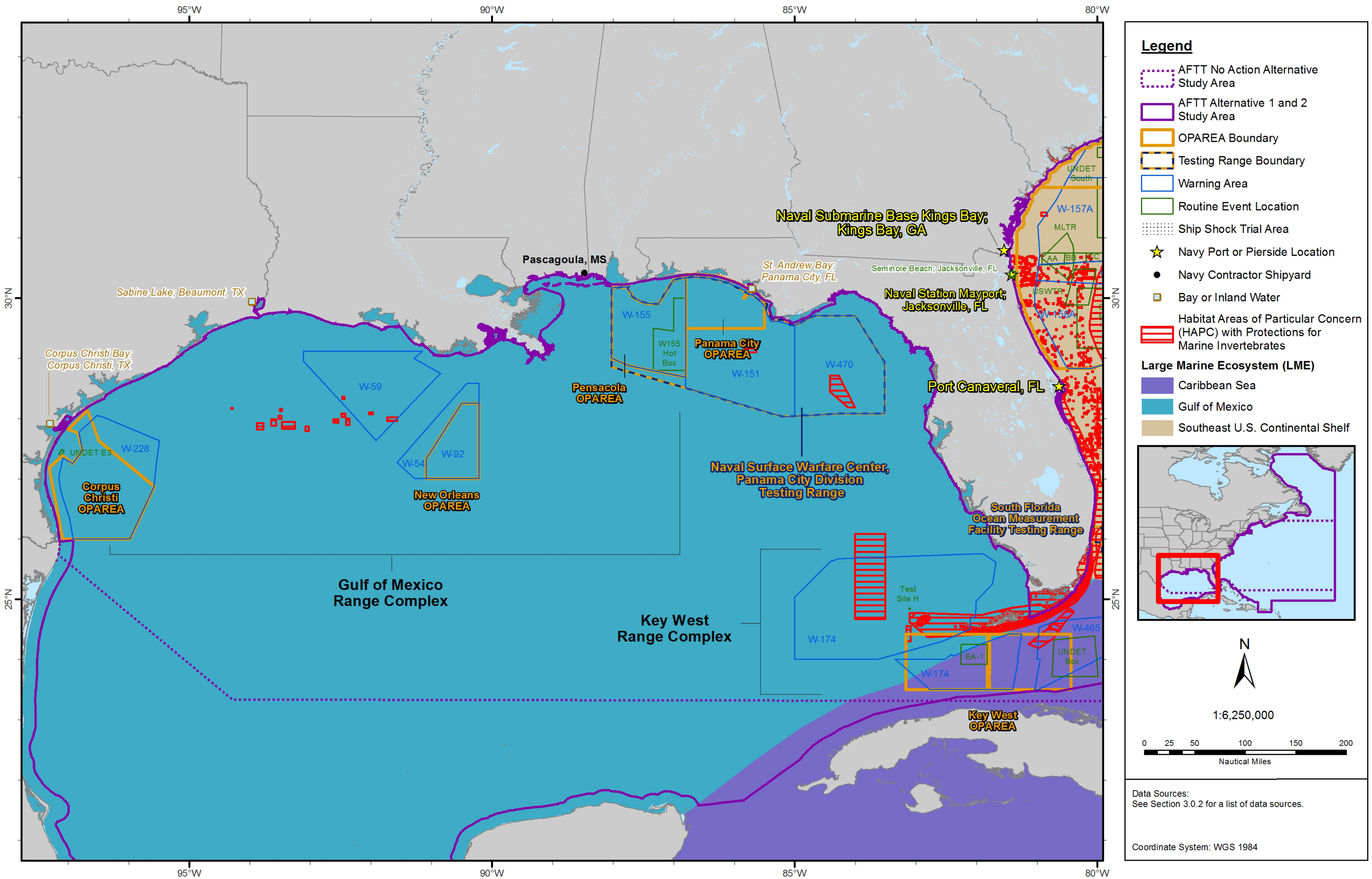

Figure 3.8-3: Habitat Areas of Particular Concern within the Gulf of Mexico Portion of the Study Area

AFTT: Atlantic Fleet Training and Testing; FL: Florida; GA: Georgia; MLTR: Missile Laser Training Range; MS: Mississippi; OPAREA: Operating Area; TX: Texas; UNDET: Underwater Detonation; USWTR: Undersea Warfare Training Range decrease in the pH of the ocean linked to global climate change (Cohen et al. 2009). All these threats reduce tolerance to global climate change (Ateweberhan and McClanahan ; Carilli et al. 2010; Sheppard et al. 2009) and coral bleaching. Causes of coral bleaching are reasonably well understood and are often tied to atypically high sea temperatures (Brown 1997; Glynn 1993; van Oppen and Lough 2009). However, atypically low sea temperatures also cause substantial mortality to corals and most other reef organisms (Colella et al. 2012; Lirman et al. 2011). Human-made noise may impact coral larvae by masking the natural sounds that serve as cues to orient them toward suitable settlement sites (Vermeij et al. 2010).

Exposure to oil runoff from land, natural seepage, or spills from offshore drilling or tankers is another threat that can affect coral reefs (National Oceanic and Atmospheric Administration 2001). Factors such as the oil type, quantity, exposure time, and season can affect organism toxicity levels. Branching corals such as the ESA-listed elkhorn and staghorn corals are less resistant to oil than other types of coral (National Oceanic and Atmospheric Administration 2001). Reproductive and early life stages are especially sensitive to oil exposure (Shafir et al. 2007), which can result in coral death, delayed reproduction, altered development and growth, and altered behavior (National Oceanic and Atmospheric Administration 2001). Overall, the impact of oil spills on coral reefs is poorly documented.

Once a species is made vulnerable by human-caused events, impacts from ordinarily benign natural events can be magnified (Knowlton 2001). These factors have resulted in the coral reefs in the Study Area being described as among the most degraded in the world (Bryant et al. 1998; Pandolfi et al. 2005). Furthermore, individual species and entire evolutionary lineages of coral have been made exceptionally vulnerable to extinction (Huang 2012).

3.8.2.15.2 Deep Water Corals

3.8.2.15.2.1 Status and Management

Federally managed deep-water coral habitats focus on a suite of sessile invertebrates (Lumsden et al. 2007), and two types of reef-building coral are highlighted: *Oculina varicosa* (occurs at depths of approximately 100–500 ft. [30–150 m]) and *Lophelia pertusa* (occurs at depths of 650–2,600 ft. [200–800 m). Both are managed by the South Atlantic Fishery Management Council in Coral Habitat Areas of Particular Concern (referred to as C-HAPC in most regulatory documents) (South Atlantic Fishery Management Council 1998a). These two dominant species are used to define the Coral Habitat Areas of Particular Concern, but dozens of other habitat-forming organisms, including corals, co-occur in both habitats (Freiwald et al. 2004). Like shallow-water tropical coral reefs, these complex habitats host diverse megafauna communities that are distinct on relatively small spatial scales (e.g., as small as 0.2 acres [0.08 ha]) (Quattrini et al. 2012). The *Oculina* bank Coral Habitat Area of Particular Concern covers 300 nm^2 and lies off the coast of eastern Florida, Figure 3.8-2 (Reed et al. 2007). The *Lophelia* Coral Habitat Area of Particular Concern is 17,370 nm^2 stretching from Florida through South Carolina, with three satellite locations off North Carolina, effective 22 July 2010 (Figures 3.8-2 and 3.8-3).

3.8.2.15.2.2 Geographic Range

Both *Oculina* and *Lophelia* reefs are found in areas of rocky bottom because larvae of hard corals and most soft corals require hard substrates for settlement. Therefore, deep-water reefs are an indicator of hard bottom habitat (Figures 3.3-1 through 3.3-4), and these two habitat types are likely to be adjacent to each other (Auster et al. 2005; Reed et al. 2006). *Oculina varicosa* occurs in an unusually wide temperature range from approximately 39°F to 90°F (4°C to 32°C), although the Oculina Banks are typically 61°F (16°C) (Freiwald et al. 2004; National Oceanic and Atmospheric Administration 2010b). *Lophelia* reefs occur in water that is typically 45°F (7°C), though the range is 39°F to 55°F (4°C to 13°C)

(Buhl-Mortensen et al. 2010; National Oceanic and Atmospheric Administration 2010a; Reed et al. 2006). Both require moderate or strong currents for food delivery and many other aspects of their life histories (Lumsden et al. 2007; National Oceanic and Atmospheric Administration 2010a).

Oculina distribution in the Study Area occurs throughout the Southeast U.S. Continental Shelf Large Marine Ecosystem and Gulf of Mexico Large Marine Ecosystem at depths of 100–500 ft. (30–150 m), but extensive *Oculina* reefs are found only offshore of the central east coast of Florida (National Oceanic and Atmospheric Administration 2010b; Reed et al. 2007; South Atlantic Fishery Management Council 1998a). *Lophelia* reefs occur throughout the Study Area at depths of 650–2,600 ft. (200–800 m), with the exception of the West Greenland Shelf Large Marine Ecosystem and the Labrador Current Open Ocean Area (although Freiwald et al. (2004) suggest that this is not a true absence but rather reflects insufficient survey intensity) (National Oceanic and Atmospheric Administration 2010a; National Oceanic and Atmospheric Administration and U.S. Department of Commerce 2010; Reed et al. 2006). Relative to other parts of the Study Area, the *Lophelia* reefs in the vicinity of Navy training areas of the Jacksonville (JAX) Range Complex are exceptionally well mapped (Figures 3.3-5 and 3.3-6) (U.S. Department of the Navy 2009). Although *Lophelia* is uncommon in the vicinity of the Grand Banks, extensive soft coral gardens occur at depths of 2,000–4,300 ft. (600–1,300 m) (Murillo et al. 2011).

3.8.2.15.2.3 Abundance

Although comprehensive mapping is incomplete, the seafloor in the vicinity of the JAX Range Complex has been relatively well-mapped in the approximate depth range of 50–1,500 ft. (15–450 m) (Figures 3.3-5 and 3.3-6) (U.S. Department of the Navy 2009). Using these survey data, it is possible to estimate that any portion of the southeast U.S. continental shelf in this depth range that is approximately 440 nm^2 is likely to be 5 to 39 percent live bottom or *Lophelia* (U.S. Department of the Navy 2010). Mapping in the JAX Range Complex found different types of sandy seafloor dotted with hard bottom and mounds of coral rubble capped with relatively complex invertebrate communities. *Lophelia*, the deep-water hard coral, was often present but was infrequently dominant.

Deep-water reefs are severely degraded by fishing gear that contacts the seafloor (particularly bottom-trawling), although a suite of other human stressors also degrade these habitats (particularly coral harvesting; oil, gas, and mineral exploration and extraction; marine debris; and submarine cable/pipeline deployment) (Freiwald et al. 2004). Approximately 90 percent of the living coral on the Oculina Banks has been destroyed by physical disturbance and Reed et al. (2007) note that inadequate enforcement within the Habitat Area of Particular Concern has allowed substantial degradation to continue. Both *Oculina* and *Lophelia* are slow-growing, and reef recovery from physical damage is estimated to require decades to centuries (Freiwald et al. 2004). Increases in coral cover at damaged reefs have been documented only once, at a single *Oculina* reef (Reed et al. 2007).

Deep-water reefs support substantial fish populations and are biodiversity hotspots on continental shelves and slopes (the extent of the continent that is covered by the ocean) (Baker et al. 2012; Bongiorni et al. 2010; Ross and Quattrini 2007). Because deep-water reefs provide habitat for many commercially valuable fish species, consequences of damage carry substantial socioeconomic costs as well as habitat and ecosystem costs (Morgan and Chuenpagdee 2003).

3.8.2.15.2.4 Predator-Prey Interactions

The only known predators of deep-water corals are several species of sea stars (Freiwald et al. 2004). Corals feed on zooplankton, which are small animals that inhabit the water column. Like all cnidarians, corals capture prey with tentacles armed with stinging cells that surround the mouth or by employing a mucus net to catch suspended prey (Brusca and Brusca 2003).

3.8.2.15.2.5 Threats

There are no known species-specific threats for deep-water corals. Deep-water corals are susceptible to petroleum contamination and, once affected, show infrequent signs of recovery on short timescales (White et al. 2012). The greatest threat to deep-water coral reefs is physical strike and disturbance resulting from human-caused activities (National Oceanic and Atmospheric Administration 2010b; Reed et al. 2007). Fisheries-related damage is the single greatest threat to deep-water corals (Chuenpagdee et al. 2003; Freiwald et al. 2004). These species are extremely fragile, and even hook-and-line fishing causes extensive damage (Reed et al. 2007; Ross and Quattrini 2007).

3.8.2.15.3 Hard Bottom

3.8.2.15.3.1 Status and Management

Hard bottom (sometimes called livebottom or a variant of this) occurs on any natural structure that provides a relatively sediment-free surface for attachment, such as dead coral reefs or rock outcroppings (Lidz et al. 2006). This can occur at any depth, but hard bottom is typically encountered from the surface to approximately 2,000 ft. (600 m) in areas where water motion (e.g., waves or currents) is sufficient to prevent accumulation of unconsolidated sediment. Hard bottom itself is not a biogenic habitat *per se*, but it provides substrate for a community of habitat-forming sessile organisms that inhabit the rock structure as a living veneer. These organisms typically include sponges, hydroids, hard corals, soft corals and bivalves, and at depths less than approximately 600 ft. (200 m), hard bottom may also include vegetation (Chiappone and Sullivan 1994) (up to 30 percent attached macroalgae cover).

The South Atlantic Fishery Management Council has designated hard bottom within the Charleston Bump (a deep-water rocky outcropping) and Gray's Reef National Marine Sanctuary as Essential Fish Habitat–Habitat Areas of Particular Concern for coral. Similarly, hard bottom is managed by the Gulf of Mexico Fishery Management Council plan for habitat areas of particular concern (Gulf of Mexico Fishery Management Council 2005). Biogenic substrates are also created by worms and oysters, and these habitat-forming organisms are discussed in their respective phyla descriptions.

3.8.2.15.3.2 Geographic Range

Hard bottom is found in all large marine ecosystems of the Study Area (Figures 3.3-1 through 3.3-4). In the Southeast U.S. Continental Shelf Large Marine Ecosystem, hard bottom supporting sea fans, sea whips, hydroids, anemones, sponges, corals, and their associated fish fauna occurs on the Florida-Hatteras shelf south of Cape Hatteras, North Carolina. Natural rock hard bottom is augmented by "shell bottom," composed of living or dead oysters and hard clams, although hard bottom substrate can also comprise non-biogenic rock (e.g., basalt) (Auster et al. 2005). Shallow hard bottom off the east coast of Florida is similar to coral reefs in terms of community composition. Underdeveloped coral reefs on the periphery of mature reefs provide live hard bottom habitat around the Florida Keys. The west-central Florida inner continental shelf coast consists of exposed hard bottom containing ledges or scarps. These limestone outcroppings support complex live hard bottom communities on vertical faces up to 13 ft. (4 m) above the seafloor (Hine et al. 2003).

In the Gulf of Mexico Large Marine Ecosystem, almost all the natural shallow hard bottom habitat occurs on the west Florida shelf from the Dry Tortugas to Pensacola, Florida (Gulf of Mexico Fishery Management Council 1998). Shallow hard bottom on the Mississippi-Alabama shelf, the Texas-Louisiana shelf, and the south Texas shelf are mostly associated with oyster beds, while deep hard bottom communities are associated with nascent or degraded deep-water reefs (Thompson et al. 1999). In the Gulf of Mexico, reef fishes, such as snappers, groupers, grunts, and porgies, are associated with hard bottom habitats (U.S. Department of the Interior and Minerals Management Service 2007).

3.8.2.15.3.3 Abundance

Hard bottom habitat is more abundant than all types of biogenic habitat and is found in all large marine ecosystems of the Study Area (Figures 3.3-1 through 3.3-4). It has been reasonably well-mapped in the Southeast U.S. Continental Shelf Large Marine Ecosystem, where it occupies approximately 36 percent of the JAX Range Complex and 96 percent of the South Florida Ocean Measurement Facility Testing Range (these figures combine reef and hard bottom abundance; see Section 3.3, Marine Habitats).

3.8.2.15.3.4 Predator-Prey Interactions

Most of the habitat-forming organisms that typify hard bottom are filter-feeders or predators of zooplankton. Most of these organisms are subject to similar predation pressures as shallow-water coral reefs, principally predation by invertebrates and fish (Section 3.8.2.15.1.4, Predator-Prey Interactions).

3.8.2.15.3.5 Threats

There are no species-specific threats to hard bottom. General threats are similar to those outlined for shallow-water and deep-water corals (Sections 3.8.2.15.1.5, Threats, and 3.8.2.15.2.5, Threats). Additionally, marine debris is a stressor of this habitat, particularly for heavily-fished and frequently-visited areas (Bauer et al. 2008).

3.8.2.16 Flatworms (Phylum Platyhelminthes)

Flatworms include between 8,000 and 20,000 marine species worldwide (Appeltans et al. 2010; Castro and Huber 2000) and are the simplest form of marine worm (Castro and Huber 2000). The largest single group of flatworms are parasites commonly found in fish, seabirds, and whales (Castro and Huber 2000; University of California Berkeley 2010d). The life history of parasitic flatworms plays a role in the regulation of populations for the marine vertebrates they inhabit. Ingestion by the host organism is the primary dispersal method for parasitic flatworms. As parasites, they are not typically found in the water column, outside of a host organism. The remaining groups found throughout the Study Area are nonparasitic carnivores, living without a host. Several species of wrasses and other reef fish prey on flatworms (Castro and Huber 2000).

3.8.2.17 Ribbon Worms (Phylum Nemertea)

Ribbon worms include approximately 1,000 marine species worldwide (Appeltans et al. 2010). Ribbon worms, with their distinct gut and mouth parts, are more complex than flatworms (Castro and Huber 2000). Organisms in this phylum are bottom-dwelling, predatory marine worms that are equipped with a long extension from the mouth (proboscis) that helps them capture food (Castro and Huber 2000). Some species are also equipped with a sharp needle-like structure that delivers poison to kill prey. Ribbon worms occupy an important place in the marine food web as prey for a variety of fish and invertebrates, and as a predator of other bottom-dwelling organisms, such as worms and crustaceans (Castro and Huber 2000). Some ribbon worms are parasitic and some are commensal, occupying the inside of the mantle of molluscs where they feed on the waste products of their host (Castro and Huber 2000). Ribbon worms are found throughout the Study Area, buried in the seafloor or hiding among the rocks or vegetation (Castro and Huber 2000).

3.8.2.18 Round Worms (Phylum Nematoda)

Round worms include more than 5,000 marine species, though this number may be a gross underestimate (Appeltans et al. 2010). Round worms are small and cylindrical, and they are abundant in sediments and in host organisms as parasites (Castro and Huber 2000). Round worms are some of the most widespread marine invertebrates, with population densities of one million organisms per 11 $ft.^2$ (1 m^2) of mud (Levinton 2009). This group has a variety of food preferences, including algae, small invertebrates, annelid worms, and organic material from sediment. One genus (*Anisakis*) inhabits the digestive tracts of marine mammals, while its larvae are found in marine fishes. These nematodes may impact other organisms that consume these infected fishes, including humans (Castro and Huber 2000). Like flatworms, parasitic nematodes provide important ecosystem services by regulating populations of other marine organisms. Round worms are found throughout the Study Area.

3.8.2.19 Segmented Worms (Phylum Annelida)

Segmented worms include approximately 12,000 marine species worldwide in the phylum Annelida, although most marine forms are in the class Polychaeta (Appeltans et al. 2010). Segmented worms are the most complex group of marine worms with a well-developed respiratory and gastrointestinal system (Castro and Huber 2000). Different species of segmented worms may be highly mobile or burrow in the seafloor (Castro and Huber 2000). Most segmented worms are predators; others are scavengers, deposit feeders, filter feeders, or suspension feeders of sand, sediment, and water (Hoover 1998c). The variety of feeding strategies and close connection to the seafloor make annelids an integral part of the marine food web (Levinton 2009). Burrowing in the seafloor and agitating the sediment increase the oxygen content of the seafloor, which makes important buried nutrients available to other organisms. This ecosystem service allows bacteria and other organisms, which are also an important part of the food web, to flourish on the seafloor. Segmented worms are found throughout the Study Area inhabiting rocky, sandy, and muddy areas of the seafloor (Castro and Huber 2000). These worms also colonize vessel hulls, docks, and floating debris. Some species of worms build rigid tubes, and aggregations of these tubes form reefs. Giant tube worms (*Riftia pachyptila*) are chemosynthetic (a primary production process without sunlight) reef-forming worms living on hydrothermal vents of the abyssal oceans. Their distribution is poorly-known in the Study Area.

3.8.2.19.1 Reef-Forming Worms

3.8.2.19.2 Status and Management

Shallow water worm reefs in the Study Area are built by the reef-building tube worm (*Phragmatopoma caudata*, synonymous with *P. lapidosa*) (Read and Fauchald 2012). The worm tube is constructed of cemented sand grains, and large colonies of worms form relatively smooth mounds up to 6 ft. (2 m) high (Zale and Memfield 1989). Worm reef is protected by the South Atlantic Fishery Management Council as a Habitat Area of Particular Concern (South Atlantic Fishery Management Council 1998a).

3.8.2.19.3 Geographic Range

The species is found in the western Atlantic from Brazil to Florida, but is uncommon in the Gulf of Mexico. In the Study Area, it is particularly common in the Southeastern U.S. Continental Shelf Large Marine Ecosystem along Florida's east coast beaches, from Cape Canaveral to Miami, at depths up to 6 ft. (2 m); however, colonies are found infrequently to depths of 328 ft. (100 m) in areas with strong currents (South Atlantic Fishery Management Council 1998a; Zale and Memfield 1989).

3.8.2.19.4 Abundance

Worm reefs cover approximately 426 ac. (172 ha) of Florida's east coast (Florida Fish and Wildlife Conservation Commission 2010).

3.8.2.19.5 Predator-Prey Interactions

Phragmatopoma species, and all members of the family Sabellariidae, are filter-feeders and detritivores. They are prey for snails, crabs, and fish. These worms form elaborate reef structures that are particularly important habitat for many marine invertebrates and fish. Furthermore, because the worms often form reefs in the surf zone, they create structured habitat in an area that would otherwise be shifting sand—a much less productive habitat (Florida Fish and Wildlife Conservation Commission 2010; Zale and Memfield 1989).

3.8.2.19.6 Threats

Principal threats to *Phragmatopoma* worm reefs are dredging and beach restoration projects. Compared with other habitat-forming organisms, the reef-building tube worm is relatively resistant to physical strikes and pollution (Zale and Memfield 1989).

3.8.2.20 Bryozoans (Phylum Ectoprocta)

Bryozoans include approximately 5,000 marine species worldwide (Appeltans et al. 2010). These organisms occur throughout the Study Area at all depths. They are lace-like colony-forming animals, many of which create habitat similar in complexity to sponges (Buhl-Mortensen et al. 2010). Though most are small, some habitat-forming colonies are at least 3 ft. (1 m) in diameter (Wood et al. 2012). Habitat-forming bryozoans are most common on temperate continental shelves with relatively strong currents (Wood et al. 2012). Bryozoans attach to a variety of surfaces, including rocks, shells, wood, and algae, and feed on particles suspended in the water (Pearse 1987; University of California Berkeley 2010a). Bryozoans are of economic importance for commercial pursuits (e.g., agriculture, pharmaceutical, and chemical products), and are a nuisance that interferes with boat operations and clogs industrial water intakes and conduits (Hoover 1998a; Western Pacific Regional Fishery Management Council 2001).

3.8.2.21 Squid, Bivalves, Sea Snails, Chitons (Phylum Mollusca)

The phylum Mollusca includes approximately 27,000 marine species worldwide (Appeltans et al. 2010). These organisms occur throughout the Study Area at all depths. Sea snails and conchs (gastropods), mussels and clams (bivalves), and chitons (polyplacophorans) are marine invertebrates that possess a muscular foot usually used for mobility, and a mantle that secretes a shell, although some molluscs have lost their shell (Castro and Huber 2000). Sea snails and slugs feed on a range of plants and animals, including fleshy algae, hydroids, sponges, sea urchins, worms, and small crustaceans, as well as dead organic matter (Castro and Huber 2000; Colin and Arneson 1995c; Hoover 1998c). Clams, mussels, and other bivalves feed on phytoplankton (small floating plant-like organisms) and other suspended food particles (Castro and Huber 2000). Most gastropods and chitons use a ribbon of teeth called a radula to feed and chitons, notably, bore deep pits into rocks as they scrape algae (Pearse 1987). Squid and octopus are active swimmers at all depths of the ocean and use a beak to prey on a variety of organisms. Squids prey on fishes, shrimps, and other squids (Castro and Huber 2000; Hoover 1998c; Western Pacific Regional Fishery Management Council 2001). Octopuses prey on fishes, shrimps, crabs, and other small crustaceans (Wood 2005).

Some mollusc species are commercially important and are federally managed (Table 3.8-2). The Atlantic sea scallop population is increasing in the Northeast U.S. Continental Shelf Large Marine Ecosystem due, in part, to effective fishery management (National Marine Fisheries Service 2012). The short-finned squid (*Ilex illecebrosus*) is among relatively few highly migratory marine invertebrates. This species inhabits the open ocean during the winter and returns to the water over the continental shelf in the spring in the Northeast Large Marine Ecosystem and Southeast U.S. Continental Shelf Large Marine Ecosystem (Hendrickson 2006). It carries out vertical daily migrations, swimming near the surface at night to feed and returning to the bottom before sunrise.

3.8.2.21.1 Reef-Forming Molluscs

Many species of mollusc, principally bivalves, are habitat-forming organisms. From the intertidal *Mytilus* mussel beds to the *Bathymodiolus* mussel reefs at deep-sea hydrothermal vents, bivalves create habitats throughout the Study Area (Buhl-Mortensen et al. 2010; South Atlantic Fishery Management Council 1998a). Oysters in general, and principally the eastern oyster (*Crassostrea virginica*), are the most familiar reef-forming mollusc on the U.S. continental shelf.

3.8.2.21.1.1 Status and Management

Oyster reefs or oyster beds are highly productive biogenic habitats in nearshore inter-tidal or shallow subtidal ecosystems, providing many of the same habitat values as coral reefs ("nearshore" generally includes inshore waters and the seaward coastal area where waves break, typically about 60–600 ft. [20–200 m] from the beach). Large oyster beds also alter the physical environment in which they occur by clarifying the water as they filter-feed on particulates, and by slowing the currents which leads to sediment retention (Tyrrell 2005). Oyster reefs are substantially degraded relative to their historical abundance (Jackson et al. 2001; National Oceanic and Atmospheric Administration Fisheries Eastern Oyster Biological Review Team 2007). Oysters and oyster reefs are components of Essential Fish Habitat or Habitat Areas of Particular Concern in all five federal fishery management councils in the Study Area.

3.8.2.21.1.2 Geographic Range

Oyster beds are found in intertidal estuarine or marine habitats throughout the Study Area. A prominent reef-forming oyster, the eastern oyster, creates important habitat in nearshore subtidal areas in all large marine ecosystems in the Study Area. Biogenic habitats on the Mississippi-Alabama shelf, the Texas-Louisiana shelf, and the south Texas shelf are mostly associated with oyster beds.

3.8.2.21.1.3 Abundance

Although populations of the eastern oyster have declined appreciably in the Study Area, they still provide substantial hard bottom habitat within the Study Area (National Oceanic and Atmospheric Administration Fisheries Eastern Oyster Biological Review Team 2007).

3.8.2.21.1.4 Predator-Prey Interactions

Oysters are filter-feeders actively pumping and feeding on up to 4 gallons (15 liters) of water per hour (Keith and Anderson 2010). Oysters are prey for various marine invertebrate, fish, and bird species. Predators, such as the oyster drill (*Urosalpinx cinerea*)—a small snail—induce oysters to thicken their shells for added protection (Lord and Whitlatch 2012). Reefs formed by oysters form highly complex, physically stable habitat in areas that would otherwise be softbottom or vegetated beds. They are "keystone species" in many estuaries, including the Chesapeake Bay, which was once dominated by oysters (Jackson et al. 2001; South Atlantic Fishery Management Council 1998a).

3.8.2.21.1.5 Threats

Fishing is the principal threat to oysters, although they are also susceptible to pollution (Jackson et al. 2001; South Atlantic Fishery Management Council 1998a). Dredging is the main method of industrial-scale fishing for oysters, and this method causes great collateral damage because it destroys the oyster reef habitat and the habitat upon which the reef was formed (Chuenpagdee et al. 2003).

3.8.2.22 Shrimp, Crab, Lobster, Barnacles, Copepods (Phylum Arthropoda)

Shrimps, crabs, lobsters, barnacles, and copepods are animals with skeletons that form outside the body (Castro and Huber 2000). The skeletons are based on a polymer called chitin, similar to cellulose in plants, to which the animals add compounds such as proteins or carbonates to achieve various properties of flexibility or hardness. There are more than 50,000 species belonging to the subphylum Crustacea (Appeltans et al. 2010). These organisms occur throughout the Study Area at all depths. Shrimps, crabs, and lobsters are typically carnivorous (feed on animal tissue) or omnivorous (feed on plant and animal tissue) predators or scavengers, preying on molluscs (primarily gastropods), other crustaceans, echinoderms (e.g., sea urchins), small fishes, algae, and seagrass (Waikiki Aquarium 2009; Waikiki Aquarium and University of Hawai'i-Manoa 2009a, b; Western Pacific Regional Fishery Management Council 2001). Barnacles and copepods filter algae and small organisms from the water (Levinton 2009).

Important commercial and recreational species of arthropods in the Study Area are listed in Table 3.8-2. Possibly the most familiar is the American lobster (*Homarus americanus*); its population in the Northeast U.S. Continental Shelf Large Marine Ecosystem has increased dramatically in the past decade due, in part, to successful fishery management (National Marine Fisheries Service 2012). Some other examples include the red crab (*Chaceon quinquedens*) (New England Fishery Management Council 2010) and brown shrimp (*Penaeus aztecus*) (Gulf of Mexico Fishery Management Council 2010; South Atlantic Fishery Management Council 1998a, b).

3.8.2.23 Sea Stars, Sea Urchins, Sea Cucumbers (Phylum Echinodermata)

Organisms in this phylum include more than 6,000 marine species, such as sea stars, sea urchins, and sea cucumbers (Appeltans et al. 2010). Sea stars (asteroids), sea urchins (echinoids), sea cucumbers (holothuroids), brittle stars and basket stars (ophuiroids), and feather stars and sea lilies (crinoids) are symmetrical around the center axis of the body (Mah and Blake 2012). All echinoderms are benthic (live on the seafloor), but some can also swim. Most echinoderms have separate sexes, but unisexual forms occur among the sea stars, sea cucumbers, and brittle stars. Many species have external fertilization producing planktonic larvae, but some brood their eggs, never releasing free-swimming larvae (Colin and Arneson 1995b; Mah and Blake 2012; McMurray et al. 2012). Many echinoderms are either scavengers or predators on attached (sessile) organisms such as algae, stony corals, sponges, clams, and oysters. However, some species filter food particles from sand, mud, or water (Hoover 1998b). Echinoderms are found throughout the Study Area. An important commercial species of echinoderm in the Northeast U.S. Continental Shelf Large Marine Ecosystem is the green sea urchin (*Strongylocentrotus drobachiensis*) (Maine Department of Marine Resources 2010), although this species is not federally managed.

3.8.3 Environmental Consequences

This section presents the analysis of potential impacts on marine invertebrates, from implementation of the project alternatives, including the No Action Alternative, Alternative 1, and Alternative 2 (Preferred Alternative). Navy training and testing activities are evaluated for their potential impact on marine invertebrates in general, by taxonomic groups, and in detail for species listed under the ESA, species proposed for listing, and federally managed species or groups such as coral Habitat Areas of Particular Concern (Section 3.8.2, Affected Environment).

General characteristics of all Navy stressors were introduced in Section 3.0.5.3 (Identification of Stressors for Analysis) and living resources' general susceptibilities to stressors were introduced in Section 3.0.5.7 (Biological Resource Methods). Stressors vary in intensity, frequency, duration, and location within the Study Area. Based on the general threats to marine invertebrates discussed in Section 3.8.2 (Affected Environment), the stressors applicable to marine invertebrates in the Study Area and analyzed below include the following:

- Acoustic (sonar and other non-impulsive acoustic sources, and explosives and other impulsive acoustic sources)
- Energy (electromagnetic devices and high energy lasers)
- Physical disturbance and strike (vessels and in-water devices, military expended materials, seafloor devices)
- Entanglement (fiber optic cables, guidance wires, and parachutes)
- Ingestion (military expended materials)
- Secondary stressors

These components are analyzed for potential impacts on marine invertebrates 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 invertebrates. In addition to the analysis here, the details of all training and testing activities, stressors, components that cause the stressor, and geographic occurrence within the Study Area are summarized in Section 3.0.5.3 (Identification of Stressors for Analysis) and detailed in Appendix A (Navy Activities Descriptions).

3.8.3.1 Acoustic Stressors

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. The methods used to predict acoustic effects to invertebrates build upon the Conceptual Framework for Assessing Effects from Sound-Producing Activities (Section 3.0.5.7.1). There is little information on the potential impacts on marine invertebrates from exposure to sonar, explosions, and other sound-producing activities. Most studies focused on squid or crustaceans and on the consequences of exposures to broadband impulsive airguns typically used for seismic exploration, rather than on sonars or explosions. Categories of potential impacts discussed in order below are direct trauma, auditory fatigue (hearing loss), auditory masking, behavioral reactions, and physiological stress.

Direct trauma and mortality may occur due to the rapid pressure changes associated with an explosion. Most marine invertebrates lack air cavities that could make them vulnerable to trauma due to rapid pressure changes. Marine invertebrates could also be displaced by a shock wave, which could cause injury.

To experience hearing impacts, masking, behavioral reactions, or physiological stress, a marine invertebrate must be able to perceive sound. Marine invertebrates are likely only sensitive to water particle motion caused by nearby lower-frequency sources, and likely do not sense distant or mid- and high-frequency sounds (Section 3.8.2.1, Invertebrate Hearing and Vocalization).

Little is known about impacts on marine invertebrate sensory systems from exposure to sound. Only a few studies have examined acoustic impacts to statocysts, motion sensors that are present in some invertebrates. Andre et al. (2011) found progressive damage to statocyst hair cells in squid after exposure to two hours of 50 to 100 Hz sweeps at sound pressure levels of 157 to 175 dB re 1 µPa; however, it is impossible to determine whether damage was due to the sound exposure or some other aspect of capture or captivity because inappropriate and incorrect controls were used. In other reports, no damage to statocysts and no impacts on crustacean balance (another function of the statocyst) were observed in crustaceans repeatedly exposed to high-intensity airgun firings (Christian et al. 2003; Payne et al. 2007). This limited information suggests that cephalopod and crustacean statocysts may be resistant to impulsive sound impacts, but that the impact from long-term or non-impulsive sound exposures is undetermined. There are no existing data on the effects of sound on sound perception in other invertebrate groups.

Masking occurs when a sound interferes with an animal's ability to detect other biologically relevant sounds in its environment. Little is known about how marine invertebrates use sound in their environment. Some studies show that crab and coral larvae and post-larvae may use nearby reef sounds when in their settlement phase (Jeffs et al. 2003; Radford et al. 2007; Stanley et al. 2010; Vermeij et al. 2010), although it is unknown what component of reef sound is used. Larvae may sense particle motion of nearby sounds, limiting their reef sound detection range (less than 330 ft. [100 m]) (Vermeij et al. 2010). Anthropogenic sounds could mask important acoustic cues, affecting detection of settlement cues or predators, potentially affecting larval settlement patterns or survivability in highly modified acoustic environments (Simpson et al. 2011). Low-frequency sounds could interfere with perception of low-frequency rasps or rumbles among crustaceans, that may be obscured by high levels of ambient noise at ranges greater than 1 m from the source (Patek et al. 2009).

Studies of invertebrate behavioral responses to sound have focused on responses to impulsive sound. Invertebrates may be more likely to respond to a sudden intense sound than sound that gradually increases in intensity, such as from an approaching source. Some caged squid showed strong startle responses, including inking, when exposed to the first shot of broadband sound from a nearby seismic airgun (sound exposure level of 163 dB re 1 μPa^2-s), but strong startle responses were not seen when sounds were gradually increased (McCauley et al. 2000a; McCauley et al. 2000b). Slight increases in behavioral responses, such as jetting away or changes in swim speed, were observed at sound exposure levels exceeding 145 dB re 1 μPa^2-s (McCauley et al. 2000a; McCauley et al. 2000b). Other studies have shown no observable response by marine invertebrates to sounds. Snow crabs did not react to repeated firings of a seismic airgun (peak received sound pressure level was 201 dB re 1 µPa) (Christian et al. 2003), squid did not respond to killer whale echolocation clicks (higher frequency signals ranging from 199 to 226 dB re 1 µPa) (Wilson et al. 2007), and krill did not respond to a research vessel approaching at 2.7 knots (source level below 150 dB re 1 µPa) (Brierley et al. 2003). Distraction may be a consequence of some sound exposures; for example hermit crabs were shown to delay reaction to an approaching visual threat when exposed to continuous noise, potentially putting them at increased risk of predation (Chan et al. 2010a; Chan et al. 2010b).

There is some evidence of possible stress effects on invertebrates from long-term or intense sound exposure. Captive sand shrimp exposed to low-frequency noise (30 to 40 dB above ambient) continuously for three months demonstrated decreases in both growth rate and reproductive rate (Lagardère 1982). Sand shrimp showed lower rates of metabolism when kept in quiet, sound-proofed tanks than when kept in tanks with typical ambient noise (Lagardère and Régnault 1980). Repeated intense airgun exposures caused no changes in biochemical stress markers in snow crabs (Christian et al.

2003); however, some biochemical stress markers were observed in lobsters, although the study indicated this may have been due to captivity rather than noise exposure (Payne et al. 2007). The effect of long-term (multiple years), intermittent sound exposure was examined in a statistical analysis of recorded catch rate of rock lobster and seismic airgun activity (Parry and Gason 2006). No correlation was found between catch rate and seismic airgun activity, implying no long-term population impacts from intermittent anthropogenic sound exposure over long periods.

Because research on the consequences of exposing marine invertebrates to anthropogenic sounds is limited, qualitative analyses were conducted to determine the effects of the following acoustic stressors on marine invertebrates within the Study Area: non-impulsive sources (including sonar, vessel noise, aircraft overflights, and other active acoustic sources) and impulsive acoustic sources (including explosives, pile driving, airguns, and weapons firing).

3.8.3.1.1 Sonar and Other Non-Impulsive Acoustic Sources

Sources of non-impulsive underwater sound during testing and training events include broadband vessel noise (including surface ships, boats, and submarines), broadband aircraft overflight noise (fixed-wing and rotary-wing aircraft), sonar, and other active non-impulsive sources. Non-impulsive sounds associated with testing and training are described in Section 3.0.5.3.1 (Acoustic Stressors).

Surface combatant ships and submarines are designed to be quiet to evade enemy detection, whereas other Navy ships and small craft have higher source levels, similar to equivalently sized commercial ships and private vessels (see Section 3.0.5.3.1.6, Vessel Noise). Ship noise tends to be low-frequency and broadband. Broadband noise from aircraft would depend on the platform, speed, and altitude (see Section 3.0.5.3.1.7, Aircraft Overflight Noise). Any sound transmitted through the air-water interface would be strongest just below the surface and directly under the aircraft. Sonar and other active acoustic sound sources emit sound waves into the water to detect objects, safely navigate, and communicate. These sources may emit low-, mid-, high-, or very-high-frequency sounds at various sound pressure levels.

Most marine invertebrates do not have the capability to sense sound; however, some may be sensitive to nearby low-frequency and possibly lower-mid-frequency sounds, such as some active acoustic sources or vessel noise (Section 3.8.2.1, Invertebrate Hearing and Vocalization). Marine invertebrates that may detect sounds include cephalopods and crustaceans. Because marine invertebrates lack the adaptations that would allow them to sense sound pressure at long distances, the distance at which they may detect a sound is probably limited.

The relatively low sound pressure level beneath the water surface due to aircraft is likely not detectable by most marine invertebrates. For example, the sound pressure level from an H-60 helicopter hovering at 50 ft. is estimated to be about 125 dB re 1 µPa at 1 m below the surface, a sound pressure lower than other sounds to which marine invertebrates have shown no reaction (Section 3.8.3.1, Acoustic Stressors). Therefore, impacts due to aircraft overflight noise are not expected.

3.8.3.1.1.1 No Action Alternative

Training Activities

Under the No Action Alternative, training activities using sonar and other active acoustic sources could occur throughout the Study Area, but would typically occur in the Northeast U.S. Continental Shelf Large Marine Ecosystem (Northeast and Virginia Capes [VACAPES] Range Complexes), Southeast U.S. Continental Shelf Large Marine Ecosystem (Navy Cherry Point and JAX Range Complexes), and Gulf of Mexico Large Marine Ecosystem (Gulf of Mexico [GOMEX] Range Complex), as well as in the Gulf Stream and North Atlantic Gyre Open Ocean Areas. Certain portions of the Study Area, such as areas near Navy ports, airfields, and range complexes are used more heavily by vessels and aircraft than other portions of the Study Area. Navy vessel noise and aircraft overflight noise associated with training could occur in all of the range complexes and throughout the Study Area while in transit. The locations and number of activities proposed for training under the No Action Alternative are shown in Table 2.8-1 of Chapter 2 (Description of Proposed Action and Alternatives). Sounds produced during training are described in Section 3.0.5.3.1.1 (Sonar and Other Active Acoustic Sources); Section 3.0.5.3.1.6 (Vessel Noise) and Section 3.0.5.3.1.7 (Aircraft Overflight Noise).

As discussed above, most marine invertebrates cannot sense mid- or high-frequency sounds, distant sounds, or aircraft noise transmitted through the air-water interface (Section 3.8.2.1, Invertebrate Hearing and Vocalization). Most marine invertebrates would not be close enough to intense sound sources, such as some sonars, to potentially experience impacts to sensory structures. Any marine invertebrate capable of sensing sound may alter its behavior if exposed to non-impulsive sound, although it is unknown if responses to non-impulsive sounds occur. Continuous noise, such as from vessels, may contribute to masking of relevant environmental sounds, such as reef noise. Because the distance over which most marine invertebrates are expected to detect any sounds is limited and vessels would be in transit and would avoid shallow water areas such as coral reefs, any sound exposures with the potential to cause masking or behavioral responses would be infrequent and brief. Without prolonged proximate exposures, measurable impacts are not expected. Although non-impulsive underwater sounds produced during training activities may briefly impact some individuals capable of detecting sounds, intermittent exposures to non-impulsive sounds are not expected to impact survival, growth, recruitment, or reproduction of marine invertebrate populations.

Under the No Action Alternative, training activities using sonar and other active acoustic sources are not proposed in ESA-listed elkhorn and staghorn critical habitat designated in shallow waters along southern Florida and around Puerto Rico (see Table 2.8-1 of Chapter 2, Description of Proposed Action and Alternatives). In addition, vessels would avoid transit through areas containing shallow reefs. Any noise produced by transiting vessels would not result in the destruction or impairment of hard bottom or coral substrate suitable for coral settling and attachment. As with other invertebrates discussed above, non-impulsive underwater sound produced during training would not impact ESA-proposed corals, ESA-listed staghorn and elkhorn corals, or the ESA-candidate queen conch.

Pursuant to the ESA, underwater non-impulsive sound generated during training activities under the No Action Alternative:

- *will have no effect on ESA-listed elkhorn coral and staghorn coral;*
- *will have no effect on ESA-proposed boulder star coral, elliptical star coral, Lamarck's sheet coral, mountainous star coral, pillar coral, rough cactus coral, and star coral; and*
- *will have no effect on elkhorn and staghorn coral critical habitat.*

Testing Activities

Under the No Action Alternative, testing activities using sonar and other active acoustic sources could occur throughout the Study Area while in transit, but would typically occur in the Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Caribbean Sea, and Gulf of Mexico Large Marine Ecosystems, as well as in the Gulf Stream and North Atlantic Gyre Open Ocean Areas. These testing activities could occur in all the range complexes; at Naval Undersea Warfare Center Division, Newport

Testing Range; at Naval Surface Warfare Center, Panama City Division Testing Range; and pierside at Navy ports, naval shipyards, and Navy-contractor shipyards. Certain portions of the Study Area, such as areas near Navy ports and airfields, installations, and training and testing ranges are used more heavily by vessels and aircraft than other portions of the Study Area. Underwater noise from vessels and aircraft overflights associated with testing could occur in all the range complexes, the training ranges, and throughout the Study Area while in transit. The locations and number of activities proposed for testing under the No Action Alternative are shown in Table 2.8-2 and Table 2.8-3 of Chapter 2 (Description of Proposed Action and Alternatives). Sounds produced during testing are described in Section 3.0.5.3.1.1 (Sonar and Other Active Acoustic Sources), Section 3.0.5.3.1.6 (Vessel Noise), and Section 3.0.5.3.1.7 (Aircraft Overflight Noise).

As discussed above, most marine invertebrates cannot sense mid- or high-frequency sounds, distant sounds, or aircraft noise transmitted through the air-water interface (Section 3.8.2.1, Invertebrate Hearing and Vocalization). Most marine invertebrates would not be close enough to intense sound sources, such as some sonars, to potentially experience impacts to sensory structures. Any marine invertebrate capable of sensing sound may alter its behavior if exposed to non-impulsive sound, although it is unknown if responses to non-impulsive sounds occur. Continuous noise, such as from vessels, may contribute to masking of relevant environmental sounds, such as reef sound. Because the distance over which most marine invertebrates are expected to detect any sounds is limited and vessels would be in transit and would avoid shallow water areas such as coral reefs, any sound exposures with the potential to cause masking or behavioral responses would be infrequent and brief. Without prolonged proximate exposures, measurable impacts are not expected. Although non-impulsive underwater sounds produced during testing activities may briefly impact some individuals capable of detecting sound, intermittent exposures to non-impulsive sounds are not expected to impact survival, growth, recruitment, or reproduction of marine invertebrate populations.

Under the No Action Alternative, testing activities using sonar and other active acoustic sources are not proposed in ESA-listed elkhorn and staghorn critical habitat designated in shallow waters along southern Florida and around Puerto Rico (see Table 2.8-2 and Table 2.8-3 of Chapter 2, Description of Proposed Action and Alternatives). In addition, vessels would avoid transit through areas containing shallow reefs. Any noise produced by transiting vessels would not result in the destruction or impairment of hard bottom or coral substrate suitable for coral settling and attachment. As with other invertebrates discussed above, non-impulsive underwater sound produced during training would not impact ESA-proposed corals, ESA-listed staghorn and elkhorn corals, or the ESA-candidate queen conch.

Pursuant to the ESA, underwater non-impulsive sound generated during testing activities under the No Action Alternative:

- *will have no effect on ESA-listed elkhorn coral and staghorn coral;*
- *will have no effect on ESA-proposed boulder star coral, elliptical star coral, Lamarck's sheet coral, mountainous star coral, pillar coral, rough cactus coral, and star coral; and*
- *will have no effect on elkhorn and staghorn coral critical habitat.*

3.8.3.1.1.2 Alternative 1

Training Activities

Under Alternative 1, marine invertebrates would be exposed to increased amounts non-impulsive noise compared to the No Action Alternative due to increased use of sonars and other active acoustic sources; vessels; and aircraft overflights. Non-impulsive sound sources used during training would be similar to those under the No Action Alternative, with the addition of new active acoustic sources associated with the introduction of the Littoral Combat Ship. The locations of training using vessels, aircraft, and sonars would be similar to those under the No Action Alternative. As with the No Action Alternative, training activities under Alternative 1 using sonar and other active acoustic sources are not proposed in ESA-listed elkhorn and staghorn critical habitat designated in shallow waters along southern Florida and around Puerto Rico (see Table 2.8-1 of Chapter 2, Description of Proposed Action and Alternatives). The locations and number of activities proposed for training under Alternative 1 are shown in Table 2.8-1 of Chapter 2 (Description of Proposed Action and Alternatives). Sounds produced during training are described in Section 3.0.5.3.1.1 (Sonar and Other Active Acoustic Sources), Section 3.0.5.3.1.6 (Vessel Noise), and Section 3.0.5.3.1.7 (Aircraft Overflight Noise).

In comparison to the No Action Alternative, the increased use of sonars, vessels, and aircraft associated with training under Alternative 1 would increase the likelihood of exposure of marine invertebrates to non-impulsive underwater sounds. The expected impacts to any individual marine invertebrates capable of detecting the sound, however, would remain the same. For the same reasons as stated in Section 3.8.3.1.1.1 (No Action Alternative), non-impulsive sounds associated with training are not expected to impact most marine invertebrates or cause more than a short-term behavioral disturbance to some marine invertebrates capable of detecting nearby sound. No measurable impacts on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected. As with other invertebrates discussed above, non-impulsive underwater sound produced during training would not impact ESA-proposed corals, ESA-listed staghorn and elkhorn corals, or the ESA-candidate queen conch..

Pursuant to the ESA, underwater non-impulsive sound generated during training activities under Alternative 1:

- *will have no effect on ESA-listed elkhorn coral and staghorn coral;*
- *will have no effect on ESA-proposed boulder star coral, elliptical star coal, Lamarck's sheet coral, mountainous star, pillar coral, rough cactus coral, or star coral; and*
- *will have no effect on elkhorn and staghorn coral critical habitat.*

Testing Activities

Under Alternative 1, marine invertebrates would be exposed to increased amounts of sonars and active acoustic sources (including sources not analyzed under the No Action Alternative), vessel noise, and aircraft overflight noise during testing activities compared to the No Action Alternative. The locations of testing activities using vessels, aircraft, and sonars and other active acoustic sources would be similar to those under the No Action Alternative, with the addition of testing activities using sonars and active acoustic sources at the South Florida Ocean Measurement Facility Testing Range and the Key West Range Complex. As with the No Action Alternative, testing activities under Alternative 1 using sonar and other active acoustic sources are not proposed in ESA-listed elkhorn and staghorn critical habitat designated in shallow waters along southern Florida and around Puerto Rico. The locations and number of activities proposed for testing under Alternative 1 are shown in Table 2.8-2 and Table 2.8-3 of Chapter 2 (Description of Proposed Action and Alternatives). Sounds produced during testing are described in Section 3.0.5.3.1.1 (Sonar and Other Active Acoustic Sources), Section 3.0.5.3.1.6 (Vessel Noise), and Section 3.0.5.3.1.7 (Aircraft Overflight Noise).

In comparison to the No Action Alternative, the increased use of sonars, vessels, and aircraft associated with testing under Alternative 1 would increase the likelihood of exposure of marine invertebrates to non-impulsive underwater sounds. The expected impacts to any individual marine invertebrates capable of detecting the sound, however, would remain the same. For the same reasons as stated in Section 3.8.3.1.1.1 (No Action Alternative), non-impulsive sounds associated with testing are not expected to impact most marine invertebrates or cause more than a short-term behavioral disturbance to some marine invertebrates capable of detecting nearby sound. No impacts on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected.

Active acoustic sources would be used during testing activities in the Key West Range Complex, which includes ESA-listed elkhorn and staghorn coral critical habitat, and at the South Florida Ocean Measurement Facility Testing Range, which includes suitable habitat for ESA-proposed corals, and ESA-listed elkhorn and staghorn coral in shallow waters. Activities using sonar in the Key West Range Complex introduced under Alternative 1 would typically occur in water depths greater than 600 ft. (180 m) and, therefore, would not occur near elkhorn and staghorn corals or critical habitat. Activities at the South Florida Ocean Measurement Facility Testing Range could expose corals to underwater non-impulsive sound. Vessels would avoid transit through areas containing shallow reefs. Any noise produced by transiting vessels would not result in the destruction or impairment of hard bottom or coral substrate suitable for coral settling and attachment. No impacts to designated critical habitat located to the north and south of the South Florida Ocean Measurement Facility Testing Range are expected from non-impulsive sound. As with other invertebrates discussed above, non-impulsive underwater sound produced during testing would not impact ESA-proposed corals, ESA-listed staghorn and elkhorn corals, or the ESA-candidate queen conch.

Pursuant to the ESA, underwater non-impulsive sound generated during testing activities under Alternative 1:

- *will have no effect on ESA-listed elkhorn coral and staghorn coral;*
- *will have no effect on ESA-proposed boulder star coral, elliptical star coal, Lamarck's sheet coral, mountainous star, pillar coral, rough cactus coral, or star coral; and*
- *will have no effect on elkhorn and staghorn coral critical habitat.*

3.8.3.1.1.3 Alternative 2 (Preferred Alternative)

Training Activities

The number and location of training activities under Alternative 2 are identical to training activities under Alternative 1. Therefore, impacts and comparisons to the No Action Alternative will also be identical as described in Section 3.8.3.1.1.2 (Alternative 1).

Pursuant to the ESA, underwater non-impulsive sound generated during training activities under Alternative 2:

- *will have no effect on ESA-listed elkhorn coral and staghorn coral;*
- *will have no effect on ESA-proposed boulder star coral, elliptical star coal, Lamarck's sheet coral, mountainous star, pillar coral, rough cactus coral, or star coral; and*
- *will have no effect on elkhorn and staghorn coral critical habitat.*

Testing Activities

Under Alternative 2, marine invertebrates would be exposed to increased amounts of sonars and active acoustic sources, vessel noise, and aircraft overflight noise during testing activities compared to the No Action Alternative. Testing activities producing underwater non-impulsive sounds would increase by approximately 10 percent compared to Alternative 1, although the types and locations of these activities would be similar. As with the No Action Alternative, testing activities under Alternative 2 using sonar and other active acoustic sources are not proposed in ESA-listed elkhorn and staghorn critical habitat designated in shallow waters along southern Florida and around Puerto Rico. The locations and number of activities proposed for testing under Alternative 2 are shown in Table 2.8-2 and Table 2.8-3 of Chapter 2 (Description of Proposed Action and Alternatives). Sounds produced during testing are described in Section 3.0.5.3.1.1 (Sonar and Other Active Acoustic Sources), Section 3.0.5.3.1.6 (Vessel Noise), and Section 3.0.5.3.1.7 (Aircraft Overflight Noise).

In comparison to the No Action Alternative, the increased use of sonars, vessels, and aircraft associated with testing under Alternative 2 would increase the likelihood of exposure of marine invertebrates to non-impulsive underwater sounds. The expected impacts to any individual marine invertebrates capable of detecting the sound, however, would remain the same. For the same reasons as stated in Section 3.8.3.1.1.2 (Alternative 1), non-impulsive sounds associated with testing are not expected to impact most marine invertebrates or cause more than a short-term behavioral disturbance to some marine invertebrates capable of detecting nearby sound. No impacts on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected.

As described for Alternative 1, impacts from non-impulsive sound are not expected to ESA-proposed corals; ESA-listed elkhorn and staghorn corals or their critical habitat; or the ESA-candidate queen conch..

Pursuant to the ESA, underwater non-impulsive sound generated during testing activities under Alternative 2:

- *will have no effect on ESA-listed elkhorn coral and staghorn coral;*
- *will have no effect on ESA-proposed boulder star coral, elliptical star coal, Lamarck's sheet coral, mountainous star, pillar coral, rough cactus coral, or star coral; and*
- *will have no effect on elkhorn and staghorn coral critical habitat.*

3.8.3.1.1.4 Substressor Impact on Sedentary Invertebrate Beds and Reefs as Essential Fish Habitat

Pursuant to the Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of sonar and other non-impulsive sound sources during training and testing activities will have no adverse effect on sedentary invertebrate beds or reefs that constitute Essential Fish Habitat or Habitat Areas of Particular Concern.

3.8.3.1.2 Impacts from Explosives and Other Impulsive Acoustic Sources

Explosions; pile driving; weapons firing, launch, and non-explosive impacts; and airguns introduce loud, impulsive, broadband sounds into the marine environment. Impulsive sources are characterized by rapid pressure rise times and high peak pressures (Section 3.0.4, Acoustic and Explosives Primer). Explosions produce high pressure shock waves with the potential to cause injury or physical disturbance due to rapid pressure changes. Some other impulsive sources, such as airguns and impact pile driving, also produce shock waves, but of much lower intensity. Impulsive sounds are usually brief, but the associated rapid pressure changes have the potential to injure or startle.

Limited studies of crustaceans have examined mortality rates at various distances from detonations in shallow water (Aplin 1947; Chesapeake Biological Laboratory 1948; Gaspin et al. 1976). Similar studies of molluscs have shown them to be more resistant than crustaceans to explosive impacts (Chesapeake Biological Laboratory 1948; Gaspin et al. 1976). Other invertebrates found in association with molluscs, such as sea anemones, polychaete worms, isopods, and amphipods, were observed to be undamaged in areas near detonations (Gaspin et al. 1976). Using data from these experiments, Young (1991) developed curves that estimate the distance from an explosion beyond which at least 90 percent of certain marine invertebrates would survive, depending on the weight of the explosive (Figure 3.8-4).

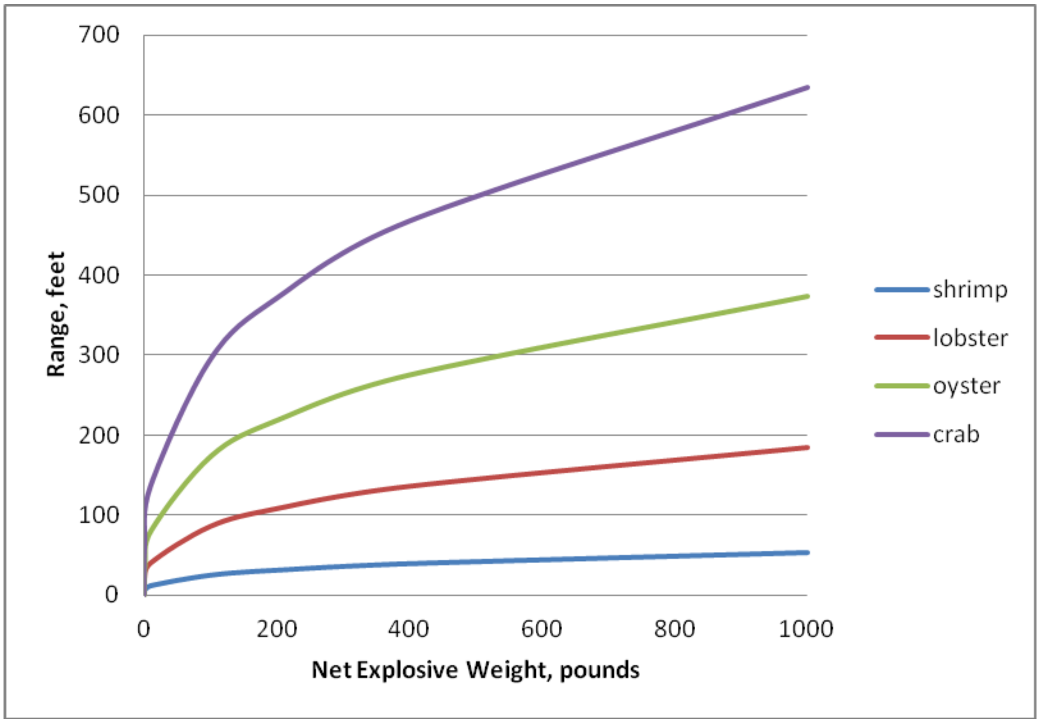

Figure 3.8-4: Distance from an Underwater Explosion where 90 Percent of Marine Invertebrates are Predicted to Survive (Young 1991)

In deeper waters where most detonations would occur, most benthic marine invertebrates would be beyond the 90 percent survivability ranges shown above, even for larger explosives (up to source class E12 [601-1,000 lb. net explosive weight]). In addition, most detonations would occur near the water surface, releasing a portion of the explosive energy into the air rather than the water and reducing impacts to marine invertebrates throughout the water column. The number of organisms affected would depend on the size of the explosive, the distance from the explosion, and the presence of groups of pelagic invertebrates. In addition to trauma caused by a shock wave, organisms could be killed in an area of cavitation that forms near the surface above large underwater detonations, such as ship shock trial charges. Cavitation is where the reflected shock wave creates a region of negative pressure followed by a collapse, or water hammer (see Section 3.0.4, Acoustic and Explosives Primer).

Some charges are detonated in shallow water or near the seafloor, including explosive ordnance disposal charges and some explosions associated with mine warfare. In addition to injuring nearby organisms, a blast near the bottom could potentially disturb hard substrate suitable for colonization (see Section 3.3.3.1, Acoustic Stressors). An explosion in the near vicinity of hard corals could cause fragmentation and siltation of the corals. However, the Navy will not conduct explosive mine countermeasures and neutralization activities within 350 yd. (320 m) of surveyed shallow coral reefs, live hard bottom, artificial reefs, and shipwrecks. Additionally, the Navy will not conduct explosive or non-explosive small-, medium-, and large-caliber gunnery exercises using a surface target, explosive missile exercises using a surface target, explosive and non-explosive bombing exercises, or at-sea explosive testing within 350 yd. (320 m) of surveyed shallow coral reefs (see Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring). Therefore, explosions are unlikely to impact shallow coral reefs or other hard substrate suitable for coral.

Impulses from pile driving and removal are broadband and carry most of their energy in the lower frequencies (see Section 3.0.5.3.1.3, Pile Driving, for a discussion of sounds produced during impact pile driving and vibratory pile removal). Impact pile driving can produce a shock wave that is transmitted to the sediment and water column (Reinhall and Dahl 2011). Nearby marine invertebrates could be killed or injured by the physical placement of the pile or by the impulses. Marine invertebrates in the area around a pile driving and vibratory removal site would be exposed to multiple impulsive sounds over an estimated 13 days during training under Alternatives 1 and 2. Repeated exposures to impulsive noise, such as pile driving, could damage structures used by some marine invertebrates to sense water motion, although studies have shown crustaceans may withstand repeated impulsive exposures without sensory damage.

Airguns have slower rise times and lower peak pressures than many explosives. Studies of airgun impacts on marine invertebrates have used seismic airguns, which are more powerful than any airguns proposed for use during Navy testing. Studies of crustaceans have shown that adult crustaceans were not noticeably physically affected by exposures to intense seismic airgun use (Christian et al. 2003; Payne et al. 2007). Snow crab eggs repeatedly exposed to airgun firings had slightly increased mortality and apparent delayed development (Christian et al. 2003), but Dungeness crab larvae were not affected by repeated exposures (Pearson et al. 1993). Some squid showed strong startle responses, including inking, when exposed to the first shot of broadband sound from a nearby seismic airgun (sound exposure level of 163 dB re 1 μPa^2-s), but strong startle responses were not seen when sounds were gradually increased (McCauley et al. 2000a; McCauley et al. 2000b). Seismic airguns were implicated in giant squid strandings by an unpublished report (Guerra and Gonzales 2006; Guerra et al. 2004). Although analysis of the damage to the stranded squid was inconclusive (tissues samples were degraded) and proximity to the airguns was unknown, the report hypothesized that the squid may have become disoriented due to statolith damage or may have been close enough to experience shock wave impacts. Airguns used during testing of swimmer defense systems are intended to be non-lethal swimmer deterrents and are substantially less powerful than those used in seismic studies. It is unlikely they would injure marine invertebrates. Some pelagic invertebrates such as squid within a short distance may startle and swim away from these airguns.

Firing weapons on a ship generates sound by firing the gun (muzzle blast), the shell flying through the air, and vibration from the blast propagating through the ship's hull (see Section 3.0.5.3.1.5, Weapons Firing, Launch, and Impact Noise). In addition, larger non-explosive munitions and targets could produce loud impulsive noise when hitting the water, depending on the size, weight, and speed of the object at impact (McLennan 1997). Small- and medium-caliber munitions are not expected to produce substantial impact noise.

Based on studies with airguns, some marine invertebrates exposed to impulsive sounds from airguns and weapons firing may exhibit startle reactions, such as inking by a squid or changes in swim speed. Similarly, marine invertebrates beyond the range to any injurious effects from exposure to explosions or pile driving may also exhibit startle reactions. Repetitive impulses during pile driving or multiple explosions, such as during a firing exercise, may be more likely to have injurious effects or cause avoidance reactions. However, impulsive sounds produced in water during testing and training are single impulses or multiple impulses over a limited duration (e.g., gun firing or driving a pile). Any auditory masking, in which the sound of an impulse could prevent detection of other biologically relevant sounds, would be very brief.

At a distance, impulses lose their high pressure peak and take on characteristics of non-impulsive acoustic waves. Similar to the impacts expected for non-impulsive sounds discussed previously, it is expected these exposures would cause no more than brief startle reactions in some marine invertebrates.

3.8.3.1.2.1 No Action Alternative

Training Activities

Under the No Action Alternative, marine invertebrates would be exposed to explosions at or beneath the water surface and underwater impulsive noise from weapons firing, launches, and impacts of non-explosive munitions during training activities. Training activities under the No Action Alternative would not include pile driving or airguns.

Noise could be produced by explosions, weapons firing, launches, and impacts of non-explosive munitions throughout the Study Area, but would typically occur in the Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems, and in the Gulf Stream Open Ocean Area. Explosives at or beneath the water surface would be used in all training range complexes, except that typically none would be used in Key West Range Complex. The number of training events using explosives, weapons firing, launches, and non-explosive munitions and their proposed locations are presented in Table 2.8-1 of Chapter 2 (Description of Proposed Action and Alternatives). A discussion of explosives and the number of detonations in each source class are provided in Section 3.0.5.3.1.2 (Explosives). The types of noise produced during weapons firing, launches, and non-explosive munitions impact are discussed in Section 3.0.5.3.1.5 (Weapons Firing, Launch, and Impact Noise). The largest source class proposed for training under the No Action Alternative is E12 (651-1,000 pounds [lb.] net explosive weight), used during bombing exercises (air-to-surface) and sinking exercises.

In general, explosive events would consist of a single explosion or a few smaller explosions over a short period. Some marine invertebrates (pelagic and benthic) close to a detonation would likely be killed, injured, broken, or displaced. Most detonations would occur greater than 3 nm from shore. As water depth increases away from shore, benthic invertebrates would be less likely to be impacted by detonations at or near the surface. In addition, detonations near the surface would release a portion of their explosive energy into the air, reducing the explosive impacts in the water.

Many corals and hard bottom invertebrates are sessile, fragile, and particularly vulnerable to shock wave impacts. Many of these organisms are slow-growing and could require decades to recover (Precht et al. 2001). Explosive impacts on benthic invertebrates are more likely when an explosive is large compared to the water depth or when an explosive is detonated at or near the bottom; however, most explosions would occur at or near the water surface, reducing the likelihood of bottom impacts. The Navy will not conduct explosive mine countermeasures and neutralization activities within 350 yd. (320 m) of surveyed shallow coral reefs, live hard bottom, artificial reefs, and shipwrecks. Additionally, the Navy will not conduct explosive or non-explosive small-, medium-, and large-caliber gunnery exercises using a surface target, explosive missile exercises using a surface target, explosive and non-explosive bombing exercises, or at-sea explosive testing within 350 yd. (320 m) of surveyed shallow coral reefs (see Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring). Therefore, explosions are unlikely to impact shallow coral reefs or other hard substrate suitable for coral.

Noise produced by weapons firing, launches, and impacts of non-explosive munitions would consist of a single or several impulses over a short period and would likely not be injurious.

Some marine invertebrates may be sensitive to the low-frequency component of impulsive sound, and they may exhibit startle reactions or temporary changes in swim speed in response to an impulsive exposure. Because exposures are brief, limited in number, and spread over a large area, no long-term impacts due to startle reactions or short-term behavioral changes are expected. Although individual marine invertebrates may be injured or killed during an explosion, no long-term impacts on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected.

Underwater impulsive noise from weapons firing, launches, or impacts of non-explosive munitions would not occur during training in the Key West Range Complex or in the waters off southern Florida near ESA-listed elkhorn and staghorn corals or their designated critical habitat. Mine neutralization-explosive ordnance disposal activities in the Key West Range Complex would occur in sandy bottom areas that are not near ESA-listed elkhorn and staghorn coral critical habitat. Mitigation measures described above and in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) would prohibit detonations near known shallow water coral reefs, including areas known to be inhabited by ESA-listed and ESA-proposed corals. The ESA-candidate queen conch could be exposed to energy and noise from explosions in the shallow, sandy portions of the Key West Range Complex, and similar to other invertebrates, individual queen conch could be disturbed, injured, or killed by the detonation, and population level impacts are unlikely.

Pursuant to the ESA, explosions and underwater impulsive sound generated during training activities under the No Action Alternative:

- *will have no effect on ESA-listed elkhorn coral and staghorn coral;*
- *will have no effect on ESA-proposed boulder star coral, elliptical star coral, Lamarck's sheet coral, mountainous star coral, pillar coral, rough cactus coral, and star coral; and*
- *will have no effect on elkhorn and staghorn critical habitats.*

Testing Activities

Under the No Action Alternative, marine invertebrates would be exposed to explosions at or beneath the water surface and underwater impulsive sounds from airguns, weapons firing, launches, and impacts of non-explosive munitions during testing activities. Testing activities under the No Action Alternative would not include pile driving.

Noise could be produced by explosives, weapons firing, launches, and impacts of non-explosive munitions throughout the Study Area, but would typically occur in the Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems, and in the Gulf Stream Open Ocean Area. Underwater impulsive sounds or explosions at or near the water surface could occur in all of the testing ranges and range complexes, except typically none would occur in the Key West Range Complex. Airguns would be used at nearshore locations during pierside integrated swimmer defense activities at Joint Expeditionary Base Little Creek, Norfolk, Virginia, and at Newport, Rhode Island. The number of testing events using explosives, airguns, weapons firing, launches, and non-explosive munitions and their proposed locations are presented in Table 2.8-2 and Table 2.8-3 of

Chapter 2 (Description of Proposed Action and Alternatives). A discussion of explosives and the number of detonations in each source class are provided in Section 3.0.5.3.1.2 (Explosives). The types of noise produced during weapons firing, launches, and non-explosive munitions impact are discussed in Section 3.0.5.3.1.5 (Weapons Firing, Launch, and Impact Noise). Noise produced by the firing of airguns is discussed in Section 3.0.5.3.1.4 (Swimmer Defense Airguns). The largest source class proposed for testing under the No Action Alternative is E14 (1,741-3,625 lb. net explosive weight), used during ordnance testing at Naval Surface Warfare Center, Panama City Division Testing Range.

In general, explosive events would consist of a single explosion or a few smaller explosions over a short period. Some marine invertebrates (pelagic and benthic) close to a detonation would likely be killed, injured, broken, or displaced. As water depth increases, benthic invertebrates would be less likely to be impacted by detonations at or near the surface. In addition, detonations near the surface would release a portion of their explosive energy into the air, reducing the explosive impacts in the water.

Many corals and hard bottom invertebrates are sessile, fragile, and particularly vulnerable to shock wave impacts. Many of these organisms are slow-growing and could require decades to recover (Precht et al. 2001). Explosive impacts on benthic invertebrates are more likely when an explosive is large compared to the water depth or when an explosive is detonated at or near the bottom; however, most explosions would occur at or near the water surface, reducing the likelihood of bottom impacts. The Navy will not conduct explosive mine countermeasures and neutralization activities within 350 yd. (320 m) of surveyed shallow coral reefs, live hard bottom, artificial reefs, and shipwrecks. Additionally, the Navy will not conduct explosive or non-explosive small-, medium-, and large-caliber gunnery exercises using a surface target, explosive missile exercises using a surface target, explosive and non-explosive bombing exercises, or at-sea explosive testing within 350 yd. (320 m) of surveyed shallow coral reefs (see Chapter 5, Standard Operating Procedures, Mitigation, and Monitoring). Therefore, explosions are unlikely to impact shallow coral reefs or other hard substrate suitable for coral.

Noise produced by swimmer defense airguns, weapons firing, launches, and impacts of non-explosive munitions would consist of a single or several impulses over a short period and would likely not be injurious.

Some marine invertebrates may be sensitive to the low-frequency component of impulsive sound, and they may exhibit startle reactions or temporary changes in swim speed in response to an impulsive exposure. Because impulsive exposures are brief, limited in number, and spread over a large area, no long-term impacts due to startle reactions or short-term behavioral changes are expected. Although individual marine invertebrates may be injured or killed during an explosion, no impacts on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected.

No testing activities involving explosions or underwater impulsive noise from airguns, weapons firing, launches, or impacts of non-explosive munitions would occur in the Key West Range Complex or in the waters off southern Florida near ESA-proposed corals, ESA-listed elkhorn and staghorn corals, or their designated critical habitat. Additionally, mitigation measures described above and in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) would prohibit detonations near known shallow water coral reefs, including areas known to be inhabited by ESA-listed and ESA-proposed corals. The ESA-candidate queen conch could be exposed to energy and noise from explosions in the shallow, sandy portions of the Naval Surface Warfare Center, Panama City Division Testing Range. Similar to other invertebrates, individual queen conch could be disturbed, injured, or killed by the detonation, and population level impacts are unlikely.

Pursuant to the ESA, explosions and underwater impulsive sound generated during testing activities under the No Action Alternative:

- *will have no effect on ESA-listed elkhorn coral and staghorn coral;*
- *will have no effect on ESA-proposed boulder star coral, elliptical star coral, Lamarck's sheet coral, mountainous star coral, pillar coral, rough cactus coral, and star coral; and*
- *will have no effect on elkhorn coral and staghorn coral critical habitats.*

3.8.3.1.2.2 Alternative 1

Training Activities

Under Alternative 1, marine invertebrates would be exposed to additional explosions and increased amounts of underwater impulsive sounds due to increased amounts of weapons firing, launches, and impacts of non-explosive munitions during training activities. In addition, pile driving would occur during construction of the elevated causeway nearshore and within the surf zone once a year at one of the following locations: Joint Expeditionary Base (East)- Fort Story, Virginia Beach, Virginia; Joint Expeditionary Base (West)- Little Creek, Virginia Beach, Virginia; or Marine Corps Base Camp Lejeune, Jacksonville, North Carolina. Training activities under Alternative 1 do not include airguns.

Although training would increase, it would generally occur in the same areas as under the No Action Alternative, with the addition of explosives used during mine neutralization- explosive ordnance disposal. The largest source class proposed for training under Alternative 1 is E12 (651-1,000 lb. net explosive weight), used during bombing exercises (air-to-surface) and sinking exercises. The number of training events using explosives, weapons firing, launches, and non-explosive munitions and their proposed locations are presented in Table 2.8-1 of Chapter 2 (Description of Proposed Action and Alternatives). A discussion of explosives and the number of detonations in each source class are provided in Section 3.0.5.3.1.2 (Explosives). The types of noise produced during weapons firing, launches, and non-explosive munitions impact are discussed in Section 3.0.5.3.1.5 (Weapons Firing, Launch, and Impact Noise). Pile driving noise is discussed in Section 3.0.5.3.1.3 (Pile Driving).

Although more marine invertebrates could be exposed to explosions at or near the water surface and underwater impulsive noise due to weapons firing, launches, and non-explosive munitions impacts, the type of impacts to individual marine invertebrates are expected to remain the same as those described under the No Action Alternative (Section 3.8.3.1.2.1, No Action Alternative). The addition of pile driving could cause additional injury, mortality, displacement, or disturbance of marine invertebrates in the vicinity of the construction area; however, this event would occur just once per year, and impacts at the proposed sandy beach locations would be recoverable. Because impulsive exposures are brief, limited in number, spread over a large area, no long-term impacts due to startle reactions or short-term behavioral changes are expected. Although individual marine invertebrates may be injured or killed during an explosion or during pile driving, no impacts on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected.

No underwater impulsive noise from weapons firing, launches, or impacts of non-explosive munitions would occur during training in the Key West Range Complex or in the waters off southern Florida near ESA-proposed corals, ESA-listed elkhorn and staghorn corals or their designated critical habitat. Mine neutralization- explosive ordnance disposal activities proposed at the Key West Range Complex would occur in sandy bottom areas that are not near critical habitat. Additionally, mitigation measures described in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) would prohibit detonations near known shallow water coral reefs, including areas known to be inhabited by ESA-listed and ESA-proposed corals. The ESA-candidate queen conch could be exposed to energy and noise from explosions in the shallow, sandy portions of the Key West Range Complex. Similar to other invertebrates, individual queen conch could be disturbed, injured, or killed by the detonation, and population level impacts are unlikely.

Pursuant to the ESA, explosions and underwater impulsive sound generated during training activities under Alternative 1:

- *will have no effect on ESA-listed elkhorn and staghorn corals;*
- *will have no effect on ESA-proposed boulder star coral, elliptical star coral, Lamarck's sheet coral, mountainous star coral, pillar coral, rough cactus coral, and star coral; and*
- *will have no effect on elkhorn and staghorn coral critical habitat.*

Testing Activities

Under Alternative 1, marine invertebrates would be exposed to additional explosions at or beneath the water surface and increased amounts of underwater impulsive sounds due to airguns, weapons firing, launch, and impacts of non-explosive munitions during testing activities. Testing activities under Alternative 1 would not include pile driving. The description, number, and proposed locations of testing activities are presented in Table 2.8-2 and Table 2.8-3 of Chapter 2 (Description of Proposed Action and Alternatives).

The largest source class of explosives used during annually recurring testing events would be E14 (1,741–3,625 lb. net explosive weight). Explosives at or beneath the water surface would be used during annually recurring testing in all range complexes, plus Naval Surface Warfare Center, Panama City Division Testing Range. The most substantial increase in explosions under Alternative 1 would occur in the Southeast U.S. Continental Shelf Large Marine ecosystem and in the Gulf Stream Open Ocean Area due to the ship shock trials of three platforms in the VACAPES or JAX Range Complexes: aircraft carrier (one event in five years), destroyer (one event in five years), and littoral combat ship (two events in five years). Aircraft carrier full ship shock trials could use charges up to source class E17 (14,501 – 58,000 lb. net explosive weight). Destroyer and littoral combat ship full ship shock trials could use charges up to source class E16 (7,251 – 14,500 lb. net explosive weight). Each full ship shock trial would use up to four of these charges in total (each one detonated about a week apart). In addition, explosives use would occur in the Key West Range Complex during sonobuoy lot acceptance testing. Use of explosives and the number of detonations in each source class are provided in Section 3.0.5.3.1.2 (Explosives).

Airguns would be used at nearshore locations at Naval Undersea Warfare Center Division, Newport Testing Range, Rhode Island; Joint Expeditionary Base (West)- Little Creek, Virginia Beach, Virginia; and Naval Surface Warfare Center, Panama City Division Testing Range, Florida. Noise produced by the firing of airguns is discussed in Section 3.0.5.3.1.4 (Swimmer Defense Airguns).

Testing activities under Alternative 1 that produce in-water noise from weapons firing, launch, and impacts of non-explosive munitions with the water's surface would increase compared to the No Action Alternative. Additional types of testing activities would be conducted under Alternative 1, including weapons firing and impact noise in the Caribbean Sea Large Marine Ecosystem at the Key West Range Complex during combat system ship qualification trials. These new testing activities under Alternative 1 would not occur in waters near ESA-proposed corals, ESA-listed elkhorn and staghorn corals, or their designated critical habitat. The types of noise produced during weapons firing, launches, and non-explosive munitions impact are discussed in Section 3.0.5.3.1.5 (Weapons Firing, Launch, and Impact Noise).

The detonations during ship shock trials would injure, kill, break, or displace the marine invertebrates around the explosion, especially in the widespread zone of cavitation above the detonation (see Section 3.0.5.3.1.2, Explosives). Although ship shock trials would occur in water depths greater than 600 ft. (180 m), benthic invertebrates could also be impacted by the detonation.

Although more marine invertebrates could be exposed to explosions and impulsive noise due to airguns, weapons firing, launches, and non-explosive munitions impacts, the type of impacts to individual marine invertebrates are expected to remain the same as those described under the No Action Alternative (Section 3.8.3.1.2.1, No Action Alternative). Because impulsive exposures are brief, limited in number, and spread over a large area, no long-term impacts due to startle reactions or short-term behavioral changes are expected. Although individual marine invertebrates may be injured or killed during an explosion, no impacts on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected.

Weapons firing, launches, and impacts of non-explosive munitions during combat ship qualification trials and explosives use during sonobuoy lot acceptance testing in the Key West Range Complex would not occur near the shallow waters where ESA-proposed corals, ESA-listed elkhorn and staghorn corals, or their critical habitat occurs. Additionally, mitigation measures described in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) would prohibit detonations near known shallow water coral reefs, including areas known to be inhabited by ESA-listed and ESA-proposed corals. The ESA-candidate queen conch could be exposed to energy and noise from explosions in the shallow, sandy portions of the Naval Surface Warfare Center, Panama City Division Testing Range. Similar to other invertebrates, individual queen conch could be disturbed, injured, or killed by the detonation, and population level impacts are unlikely.

Pursuant to the ESA, explosions and underwater impulsive sound generated during testing activities under Alternative 1:

- *will have no effect on ESA-listed elkhorn coral and staghorn coral;*
- *will have no effect on ESA-proposed boulder star coral, elliptical star coral, Lamarck's sheet coral, mountainous star coral, pillar coral, rough cactus coral, and star coral; and*
- *will have no effect on elkhorn and staghorn coral critical habitat.*

3.8.3.1.2.3 Alternative 2 (Preferred Alternative)

<u>Training Activities</u>

The number and location of training activities under Alternative 2 are identical to training activities under Alternative 1. Therefore, impacts and comparisons to the No Action Alternative are identical to those described in Section 3.8.3.1.2.2 (Alternative 1).

Pursuant to the ESA, explosions and underwater impulsive sound generated during training activities under Alternative 2:

- *will have no effect on ESA-listed elkhorn coral and staghorn coral;*
- *will have no effect on ESA-proposed boulder star coral, elliptical star coral, Lamarck's sheet coral, mountainous star coral, pillar coral, rough cactus coral, and star coral; and*
- *will have no effect on elkhorn and staghorn coral critical habitat.*

Testing Activities

Under Alternative 2, marine invertebrates would be exposed to additional explosions at or beneath the water surface and increased amounts of underwater impulsive sounds due to airguns, weapons firing, launches, and impacts of non-explosive munitions during testing activities compared to the No Action Alternative. Annually recurring testing activities would increase by approximately 10 percent compared to Alternative 1. The types of testing activities (both annually recurring activities and ship shock trials), source classes, and locations would be the same as those under Alternative 1. Testing activities under Alternative 2 would not include pile driving. The description, number, and proposed locations of testing activities are presented in Table 2.8-2 and Table 2.8-3 of Chapter 2 (Description of Proposed Action and Alternatives).

The detonations during ship shock trials would injure, kill, break, or displace the marine invertebrates around the explosion, especially in the widespread zone of cavitation above the detonation (see Section 3.0.5.3.1.2, Explosives). Although ship shock trials would occur in water depths greater than 600 ft. (180 m), benthic invertebrates could also be impacted by the detonation.

Although more marine invertebrates could be exposed to explosions at or near the water surface and underwater impulsive noise due to airguns, weapons firing, launches, and non-explosive munitions impacts, the type of impacts to individual marine invertebrates are expected to remain the same as those described under the No Action Alternative (Section 3.8.3.1.2.1, No Action Alternative). Because impulsive exposures are brief, limited in number, and spread over a large area, no long-term impacts due to startle reactions or short-term behavioral changes are expected. Although individual marine invertebrates may be injured or killed during an explosion, no impacts on the survival, growth, recruitment, or reproduction of marine invertebrate populations are expected.

Weapons firing, launches, and impacts of non-explosive munitions during combat ship qualification trials and explosives use during sonobuoy lot acceptance testing in the Key West Range Complex would not occur near the shallow waters where ESA-proposed corals, ESA-listed elkhorn and staghorn corals, or their critical habitat occurs. Additionally, mitigation measures described in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) would prohibit detonations near known shallow water coral reefs, including areas known to be inhabited by ESA-listed and ESA-proposed corals. The ESA-candidate queen conch could be exposed to energy and noise from explosions in the shallow, sandy portions of the Naval Surface Warfare Center, Panama City Division Testing Range. Similar to other invertebrates, individual queen conch could be disturbed, injured, or killed by the detonation, and population level impacts are unlikely.

Pursuant to the ESA, explosions and underwater impulsive sound generated during testing activities under Alternative 2:

- *will have no effect on ESA-listed elkhorn coral and staghorn coral;*
- *will have no effect on ESA-proposed boulder star coral, elliptical star coral, Lamarck's sheet coral, mountainous star coral, pillar coral, rough cactus coral, and star coral; and*
- *will have no effect on elkhorn and staghorn coral critical habitat.*

3.8.3.1.2.4 Substressor Impacts on Sedentary Invertebrate Beds or Reefs as Essential Fish Habitat

Pursuant to the Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of explosives and pile driving during training and testing activities may have an adverse effect on Essential Fish Habitat by reducing the quality or quantity of water column (sound and electro-chemical environment) and sedentary invertebrate beds or reefs that constitute Essential Fish Habitat or Habitat Areas of Particular Concern (U.S. Department of the Navy 2013). All adverse impacts would be minimal and temporary to long-term. The use of swimmer defense airguns and weapons firing, launch, and impact noise during training and testing activities would not have an adverse effect on Essential Fish Habitat by reducing the quality or quantity of sedentary invertebrate beds or offshore reefs that constitute Essential Fish Habitat or Habitat Areas of Particular Concern (U.S. Department of the Navy 2013).

3.8.3.2 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) electromagnetic devices, and (2) high energy lasers.

3.8.3.2.1 Impacts from Electromagnetic Devices

Several different types of electromagnetic devices are used during training and testing activities. For a discussion of the types of activities that use electromagnetic devices, where they are used, and how many activities would occur under each alternative, see Section 3.0.5.3.2.1 (Electromagnetic Devices). Aspects of electromagnetic stressors that are applicable to marine organisms in general are presented in Section 3.0.5.7.2 (Conceptual Framework for Assessing Effects from Energy-Producing Activities).

Little information exists regarding marine invertebrates' susceptibility to electromagnetic fields. Most corals are thought to use water temperature, day length, and tidal fluctuations as cues for spawning. Magnetic fields are not known to control coral spawning release or larval settlement. Some arthropods (e.g., spiny lobster and American lobster) can sense magnetic fields, and this is thought to assist the animal with navigation and orientation (Lohmann et al. 1995; Normandeau et al. 2011). These animals travel relatively long distances during their lives, and it is possible that magnetic field sensation exists for other invertebrates that travel long distances. Marine invertebrates, including several commercially important species and federally managed species, have the potential to use magnetic cues (Normandeau et al. 2011). Susceptibility experiments have focused on arthropods, but several molluscs and echinoderms are also susceptible. However, because susceptibility is variable within taxonomic groups it is not possible to make generalized predictions for groups of marine invertebrates. Sensitivity thresholds vary by species ranging from 0.3–30 milliTesla (mT), and responses included non-lethal physiological and behavioral changes (Normandeau et al. 2011). For reference, the Earth's magnetic field is approximately 50 microTesla (μT), roughly a thousand times weaker than these thresholds (Hore

2012; Normandeau et al. 2011). The primary use of magnetic cues seems to be navigation and orientation. Human-introduced electromagnetic fields have the potential to disrupt these cues and interfere with navigation, orientation, and migration.

With the exception of magnetic cues for navigation and orientation, no physiological effects from electromagnetic fields have yet been substantiated (Hore 2012). Because electromagnetic fields weaken exponentially with distance from the source, large and sustained magnetic fields present greater exposure risks than small and transient fields, even if the small field is many times stronger than the earth's magnetic field (Normandeau et al. 2011). Transient or moving electromagnetic fields may cause temporary disturbance to susceptible organisms' navigation and orientation.

Important physical and biological characteristics of ESA-listed elkhorn and staghorn coral critical habitat are defined in Section 3.8.2.3.2, Habitat and Geographic Range. There is no established mechanism for energy stressors to affect important characteristics of this critical habitat. Therefore, it is not probable that energy stressors could degrade the quality, and potentially the quantity, of elkhorn and staghorn coral critical habitat.

3.8.3.2.1.1 No Action Alternative

Training Activities

As indicated in Section 3.0.5.3.2.1 (Electromagnetic Devices), under the No Action Alternative, training activities involving electromagnetic devices occur in the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems as well as the Gulf Stream Open Ocean Area—specifically within the VACAPES, Navy Cherry Point, and JAX Range Complexes. Use of electromagnetic devices is concentrated within the VACAPES Range Complex.

Species that do not occur within these specified areas—including all nine ESA-listed and proposed coral species and the ESA-candidate queen conch—would not be exposed to electromagnetic devices. Species that do occur within the areas listed above would have the potential to be exposed to electromagnetic devices.

There is no overlap of electromagnetic device use with designated critical habitat for elkhorn and staghorn coral (Sections 3.8.2.3.1 and 3.8.2.4.1, Status and Management). Therefore, electromagnetic devices would not affect elkhorn and staghorn coral critical habitat.

The impact of electromagnetic devices on marine invertebrates would be inconsequential because: (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges, (2) the number of activities involving the stressor is low, (3) exposures would be localized, temporary, and would cease with the conclusion of the activity, and (4) even for susceptible organisms such as invertebrates (e.g., some species of arthropods, molluscs, and echinoderms) the consequences of exposure are limited to temporary disruptions to navigation and orientation. Electromagnetic activities are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

Pursuant to the ESA, the use of electromagnetic devices during training activities as described under the No Action Alternative:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral;*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral; and*
- *will have no effect on elkhorn and staghorn coral critical habitat.*

Testing Activities

As indicated in Section 3.0.5.3.2.1 (Electromagnetic Devices), under the No Action Alternative, testing activities involving electromagnetic devices occur in the Northeast U.S. Continental Shelf and Gulf of Mexico Large Marine Ecosystems—specifically within Naval Surface Warfare Center, Panama City Division Testing Range and the VACAPES Range Complex.

Species that do not occur within these specified areas—including all nine ESA-listed and proposed coral species—would not be exposed to electromagnetic devices. Species that do occur within the areas listed above—including the ESA-candidate queen conch—would have the potential to be exposed to the electromagnetic devices.

There is no overlap of electromagnetic device use with designated critical habitat for elkhorn and staghorn coral (Sections 3.8.2.3.1 and 3.8.2.4.1, Status and Management). Therefore, electromagnetic devices would not affect elkhorn and staghorn coral critical habitat.

The impact of electromagnetic devices on marine invertebrates would be inconsequential because: (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges, (2) the number of activities involving the stressor is low, (3) exposures would be localized, temporary, and would cease with the conclusion of the activity, and (4) even for susceptible organisms, such as invertebrates (e.g., some species of arthropods, molluscs, and echinoderms), the consequences of exposure are limited to temporary disruptions to navigation and orientation. Electromagnetic activities are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

Pursuant to the ESA, the use of electromagnetic devices during testing activities as described under the No Action Alternative:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral;*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral; and*
- *will have no effect on elkhorn and staghorn coral critical habitat.*

3.8.3.2.1.2 Alternative 1

Training Activities

As indicated in Section 3.0.5.3.2.1 (Electromagnetic Devices), under Alternative 1, the use of electromagnetic devices in the Study Area would increase by less than two percent compared to the No Action Alternative. Training activities involving electromagnetic devices would continue to occur in the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems as well as the Gulf Stream Open Ocean Area—specifically within the VACAPES, Navy Cherry Point, and JAX Range Complexes. In addition, activities would be introduced within the Gulf of Mexico Large Marine Ecosystem—specifically within the GOMEX Range Complex, as well as in one of the following bays or inland waters: Sandy Hook Bay, Earle, New Jersey; lower Chesapeake Bay, Hampton Roads, Virginia; Beaufort Inlet Channel, Morehead City, North Carolina; Cape Fear River, Wilmington, North Carolina; St. Andrew Bay, Panama City, Florida; Sabine Lake, Beaumont, Texas; and Corpus Christi Bay, Corpus Christi, Texas. Electromagnetic device activities would remain concentrated within the VACAPES Range Complex.

Species that do not occur within these specified areas—including all nine ESA-listed and proposed coral species—would not be exposed to electromagnetic devices. Species that do occur within the areas listed above—including the ESA-candidate queen conch—would have the potential to be exposed to electromagnetic devices.

There is no overlap of electromagnetic device use with designated critical habitat for elkhorn and staghorn coral (Sections 3.8.2.3.1 and 3.8.2.4.1, Status and Management). Therefore, electromagnetic devices would not affect elkhorn and staghorn coral critical habitat.

As discussed in Section 3.8.3.2.1.1 (No Action Alternative), the impact of electromagnetic devices on marine invertebrates would be inconsequential. Considering the minor increase in activities in previously identified locations and introduction of activities in the additional locations, the potential impacts remain inconsequential. As described in the No Action Alternative, the increase in electromagnetic activities are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

Pursuant to the ESA, the use of electromagnetic devices during training activities as described under Alternative 1:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral;*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral; and*
- *will have no effect on elkhorn and staghorn coral critical habitat.*

Testing Activities

As indicated in Section 3.0.5.3.2.1 (Electromagnetic Devices), under Alternative 1, electromagnetic device use would increase by approximately 14 percent in the Study Area as compared to the No Action Alternative. Testing activities involving electromagnetic devices would continue to occur in the Northeast U.S. Continental Shelf and Gulf of Mexico Large Marine Ecosystems—specifically within the Naval Surface Warfare Center, Panama City Division Testing Range and the VACAPES Range Complex. In addition, activities will be introduced in the JAX Range Complex and the South Florida Ocean Measurement Facility Testing Range (both within the Southeast U.S. Continental Shelf Large Marine Ecosystem), and anywhere within the Gulf of Mexico. Activities involving electromagnetic device use would remain concentrated within the Naval Surface Warfare Center, Panama City Division Testing Range.

Species that do not occur within these specified areas would not be exposed to electromagnetic devices. Species that do occur within the areas listed above—including all nine ESA-listed and proposed coral species, and the ESA-candidate queen conch—would have the potential to be exposed to electromagnetic devices.

There is no overlap of electromagnetic device use with designated critical habitat for elkhorn and staghorn coral (Sections 3.8.2.3.1 and 3.8.2.4.1, Status and Management). The entire footprint of the South Florida Ocean Measurement Facility Testing Range is exempt from elkhorn and staghorn coral critical habitat designation. Therefore, electromagnetic devices would not affect elkhorn and staghorn coral critical habitat.

As discussed in Section 3.8.3.2.1.1 (No Action Alternative), the impact of electromagnetic devices on marine invertebrates would be inconsequential. Considering the minor increase in activities in previously identified locations and introduction of activities in the additional locations, the potential impacts remain inconsequential. Although Alternative 1 introduces activities where corals occur in the JAX Range Complex and South Florida Ocean Measurement Facility Testing Range, there is no evidence to suggest that corals can detect or respond to electromagnetic energy. As described in the No Action Alternative, the increase in electromagnetic activities is not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

As discussed in 3.0.5.3.2.1 (Electromagnetic Devices), Alternative 1 includes the introduction of kinetic energy weapon testing in the VACAPES Range Complex. The kinetic energy weapon is a new weapon system for which there are inadequate data or information available to analyze potential impacts. However, for the reasons discussed in Section 3.8.3.2.1.1 (No Action Alternative), the potential consequences of electromagnetic devices are likely to be inconsequential.

Pursuant to the ESA, the use of electromagnetic devices during testing activities as described under Alternative 1:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral;*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral; and*
- *will have no effect on elkhorn and staghorn coral critical habitat.*

3.8.3.2.1.3 Alternative 2 (Preferred Alternative)

Training Activities

The number and location of training activities under Alternative 2 are identical to training activities under Alternative 1. Therefore, impacts and comparisons to the No Action Alternative will also be identical as described in Section 3.8.3.2.1.2 (Alternative 1).

Pursuant to the ESA, the use of electromagnetic devices during training activities as described under Alternative 2:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral;*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral; and*
- *will have no effect on elkhorn and staghorn coral critical habitat.*

Testing Activities

As indicated in Section 3.0.5.3.2.1 (Electromagnetic Devices), under Alternative 2, electromagnetic device use would increase by approximately 35 percent in the Study Area as compared to the No Action Alternative, but only increases by approximately 18 percent as compared to Alternative 1. The location of testing activities and species potentially impacted under Alternative 2 are identical to those specified under Alternative 1.

Species that do not occur within these specified areas would not be exposed to electromagnetic devices. Species that do occur within the areas listed above—including all nine ESA-listed and proposed coral species, and the ESA-candidate queen conch—would have the potential to be exposed to electromagnetic devices.

There is no overlap of electromagnetic device use with designated critical habitat for elkhorn and staghorn coral (Sections 3.8.2.3.1 and 3.8.2.4.1, Status and Management). The entire footprint of the South Florida Ocean Measurement Facility Testing Range is exempt from elkhorn and staghorn coral critical habitat designation. Therefore, electromagnetic devices would not affect elkhorn and staghorn coral critical habitat.

As discussed in Section 3.8.3.2.1.1 (No Action Alternative), the impact of electromagnetic devices on marine invertebrates would be inconsequential. Considering the minor increase in activities in previously identified locations and introduction of activities in the additional locations, the potential impacts remain inconsequential. Although Alternative 1 introduces activities where corals occur in the VACAPES and JAX Range Complexes and South Florida Ocean Measurement Facility Testing Range, there is no evidence to suggest that corals can detect or respond to electromagnetic energy. As described in the No Action Alternative, the increase in electromagnetic activities is not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

As discussed in 3.0.5.3.2.1 (Electromagnetic Devices), Alternative 2 includes the introduction of kinetic energy weapon testing in the VACAPES Range Complex. The kinetic energy weapon is a new weapon system for which there are inadequate data or information available to analyze potential impacts. However, for the reasons discussed in Section 3.8.3.2.1.1 (No Action Alternative), the potential consequences of electromagnetic devices are likely to be inconsequential.

Pursuant to the ESA, the use of electromagnetic devices during testing activities as described under Alternative 2:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral;*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral; and*
- *will have no effect on elkhorn and staghorn coral critical habitat.*

3.8.3.2.1.4 Substressor Impacts on Sedentary Invertebrate Beds or Reefs as Essential Fish Habitat (Preferred Alternative)

Pursuant to the Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of electromagnetic devices during training and testing activities would have minimal and temporary adverse effects on invertebrates that occupy water column Essential Fish Habitat or Habitat Areas of Particular Concern, and would have no adverse effect on sedentary invertebrate beds or reefs that constitute Essential Fish Habitat or Habitat Areas of Particular Concern (U.S. Department of the Navy 2013).

3.8.3.2.2 Impacts from High Energy Lasers

This section analyzes the potential impacts of high energy lasers on invertebrates. As discussed in Section 3.0.5.3.2.2 (Lasers), high energy laser weapons are designed to disable surface targets, rendering them immobile. The primary concern is the potential for an invertebrate to be struck with the laser beam at or near the water's surface, which could result in injury or death.

Marine invertebrates could be exposed to the laser only if the beam misses the target. Should the laser strike the sea surface, individual invertebrates at or near the surface, such as jellyfish, floating eggs, and larvae could potentially be exposed. The potential for exposure to a high energy laser beam decreases as water depth increases. Most marine invertebrates are not susceptible to laser exposure because they occur beneath the sea surface.

3.8.3.2.2.1 No Action Alternative

As indicated in Section 3.0.5.3.2.2 (Lasers) under the No Action Alternative, no high energy lasers would be used during training or testing activities.

3.8.3.2.2.2 Alternatives 1 and 2 (Preferred Alternative)

Training Activities

As indicated in Section 3.0.5.3.2.2 (Lasers) under Alternatives 1 and 2, no high energy lasers would be used during training activities.

Testing Activities

As indicated in Section 3.0.5.3.2.2 (Lasers) under Alternatives 1 and 2, high energy laser weapons tests would be introduced in the Northeast U.S. Continental Shelf Large Marine Ecosystem and Gulf Stream Open Ocean Area—specifically within the VACAPES Range Complex.

Invertebrate species that do not occur within the VACAPES Range Complex, or that do not occur near the sea surface, including all nine ESA-listed or proposed coral species, and the ESA-candidate queen conch would not be exposed because they occur on the seafloor. There is no overlap of high energy laser device use with designated critical habitat for elkhorn and staghorn coral (Sections 3.8.2.3.1 and 3.8.2.4.1, Status and Management). Therefore, high energy laser devices will not affect elkhorn and staghorn coral critical habitat.

Invertebrates are unlikely to be exposed to high energy lasers based on the: (1) relatively low number of events, (2) very localized potential impact area of the laser beam, and (3) temporary duration of potential impact (seconds). Activities involving high energy lasers are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level, although individuals or larvae may be impacted.

Pursuant to the ESA, the use of high energy laser during testing activities as described under Alternatives 1 and 2:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral;*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral; and*
- *will have no effect on elkhorn and staghorn coral critical habitat.*

3.8.3.2.2.3 Substressor Impacts on Sedentary Invertebrate Beds or Reefs as Essential Fish Habitat (Preferred Alternative)

Pursuant to the Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of high energy laser devices during testing activities would have minimal and temporary adverse effects on invertebrates that occupy water column Essential Fish Habitat or Habitat Areas of Particular Concern, and would have no adverse effect on sedentary invertebrate beds or reefs that constitute Essential Fish Habitat or Habitat Areas of Particular Concern (U.S. Department of the Navy 2013).

3.8.3.3 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. For a list of locations and numbers of activities that may cause physical disturbance and strikes refer to Section 3.0.5.3.3 (Physical Disturbance and Strike Stressors). The physical disturbance and strike stressors that may impact marine invertebrates include: (1) vessels and in-water devices, (2) military expended materials, and (3) seafloor devices.

Most marine invertebrate populations extend across wide areas containing hundreds or thousands of discrete patches of suitable habitat. Sessile (attached to the seafloor) invertebrate populations may be maintained by complex currents that carry adults and young from place to place (see organism descriptions in Section 3.8.2, Affected Environment, for general information on dispersal). Such widespread populations are difficult to evaluate in terms of Navy training and testing activities that occur intermittently and in relatively small patches in the Study Area. Sedentary invertebrate habitats, such as hard bottom, cover enormous areas (Figures 3.3-1 through 3.3-4). In this context, the impact of a physical strike or disturbance would impact individual organisms directly or indirectly, but not to the extent that viability of populations or species would be impacted.

With few exceptions, activities involving vessels and in-water devices are not intended to contact the seafloor. Except for amphibious activities and bottom-crawling unmanned underwater vehicles, there is no potential strike impact and limited potential disturbance impact on benthic or habitat-forming marine invertebrates.

With the exception of corals and other sessile benthic invertebrates, most invertebrate populations recover quickly from non-extractive disturbance. Other invertebrates, such as the small soft-bodied organisms that live in the bottom sediment, are thought to be well-adapted to natural physical disturbances, although recovery from human-induced disturbance is delayed by decades or more (Kaiser et al. 2002; Lindholm et al. 2011). Biogenic habitats such as coral reefs, deep coral, and sponge communities may take decades to re-grow following a strike or disturbance (Jennings and Kaiser 1998; Precht et al. 2001).

3.8.3.3.1 Impacts from Vessels and In-Water Devices

The majority of the training and testing activities under all the alternatives involve vessels, and a few of the activities involve the use of in-water devices. For a discussion of the types of activities that use vessels and in-water devices, where they are used, and how many activities would occur under each alternative, see Section 3.0.5.3.3 (Physical Disturbance and Strike Stressors). See Table 3.0-25 for a representative list of Navy vessel sizes and speeds and Table 3.0-37 for the types, sizes, and speeds of Navy in-water devices used in the Study Area. Figures 3.0-20 and 3.0-21 provide graphics that illustrate the location for the Preferred Alternative and the relative use of vessels in training and testing activities, respectively.

Vessels and in-water devices have the potential to impact marine invertebrates by disturbing the water column or sediments, or directly striking organisms (Bishop 2008). Propeller wash (water displaced by propellers used for propulsion) from vessel movement and water displaced from vessel hulls can potentially disturb marine invertebrates in the water column and are a likely cause of zooplankton mortality (Bickel et al. 2011). This localized and short-term exposure to vessel and propeller movements could displace, injure, or kill zooplankton, eggs or larvae of invertebrates, including coral and conch, and macro-invertebrates in the upper portions of the water column. Surface vessels represent the majority of vessels used in the Study Area, and these have drafts up to approximately 40–50 ft. (12–15 m), meaning that physical strikes are limited to the uppermost portion of the ocean. Disturbance caused by propeller wash can extend to approximately twice this depth. The average depth of the Atlantic Ocean is approximately 3,339 m, so approximately 99.1 percent of the water column is too deep to be exposed to physical strike or disturbance from surface vessels.

There are few sources of information on the impact of nonlethal chronic disturbance to marine invertebrates. One study of seagrass-associated marine invertebrates found that chronic disturbance from vessel wakes resulted in the long-term displacement of some marine invertebrates from the impacted area (Bishop 2008). Impacts of this type resulting from repeated exposure in shallow water are unlikely to result from Navy training and testing activities, because most vessel movements in shallow water are concentrated in well-established port facilities and associated channels (Mintz and Parker 2006).

Vessels and in-water devices do not normally collide with invertebrates that inhabit the seafloor because Navy vessels are operated in relatively deep waters and have navigational capabilities to avoid contact with these habitats. A consequence of vessel operation in shallow water is increased turbidity from stirring up bottom sediments. Turbidity can impact corals and invertebrate communities on hard bottom areas by reducing the amount of light that reaches these organisms and by increasing the effort the organism expends on sediment removal (Riegl and Branch 1995). Reef-building corals are sensitive to water clarity because of their symbiotic algae (i.e., zooxanthellae) that require sunlight to live. Encrusting organisms residing on hard bottom can be impacted by persistent silting from increased turbidity. In addition, propeller wash and physical contact with coral and hard bottom areas can cause structural damage to the substrate, as well as mortality to encrusting organisms. While information on the frequency of vessel operations in shallow water is not adequate to support a specific risk assessment, typical navigational procedures minimize the likelihood of contacting the seafloor, and most Navy vessel movements in nearshore waters are confined to established channels and ports or predictable transit lanes within the Northeast U.S. Continental Shelf and Southeast U.S. Continental Shelf Large Marine Ecosystems, primarily between Norfolk, Virginia, and Jacksonville, Florida (Mintz and Parker 2006). For example, approximately 80 percent of Naval Surface Warfare Center, Panama City Division Testing Range surface activities occur beyond St. Andrew Bay and the inshore surf zone (the nearshore area of the beach where waves break, typically about 60–600 ft. [20–200 m]) (Dean and Dalrymple 2004), while approximately 20 percent of surface operations may enter estuarine and nearshore waters.

Amphibious vessels would make contact with the seafloor in the surf zone during amphibious assault and amphibious raid operations. The Study Area extends from the seafloor up to the mean high tide line (often termed mean high water in literature). Benthic invertebrates of the surf zone, such as crabs, clams, and polychaete worms, within the disturbed area could be displaced, injured, or killed during amphibious operations. Amphibious operations take place in a limited area in the Southeast U.S. Continental Shelf Large Marine Ecosystem along Onslow Beach in North Carolina and at Naval Station Mayport, Florida, both long-established training beaches. Benthic invertebrates inhabiting these areas are adapted to a highly variable environment and are expected to rapidly re-colonize disturbed areas by immigration and larval recruitment. Studies indicate that benthic communities of high energy sandy beaches recover relatively quickly (typically within 2 to 7 months) following beach nourishment (U.S. Army Corps of Engineers 2001). Schoeman et al. (2000) found that the macrobenthic (visible organisms on the seafloor) community required between 7 and 16 days to recover following excavation and removal of sand from a 2,153 $ft.^2$ (200 m^2) quadrant from the intertidal zone of a sandy beach.

Unmanned underwater vehicles travel at relatively low speeds and are smaller than most vessels, making the risk of strike or physical disturbance to marine invertebrates very low. Zooplankton, invertebrate eggs or larvae, and macro-invertebrates in the water column could be displaced, injured, or killed by unmanned underwater vehicle movements.

3.8.3.3.1.1 No Action Alternative, Alternative 1 and Alternative 2 (Preferred Alternative)

Section 3.0.5.3.3.1 (Vessels) and Section 3.0.5.3.3.2 (In-Water Devices) provide estimates of relative vessel use and location for each of the alternatives. These estimates are based on the number of activities predicted for each alternative. While these estimates provide a prediction of use, actual Navy vessel usage is dependent on military training requirements, deployment schedules, annual budgets, and other unpredictable factors. Training and testing concentrations are most dependent on locations of Navy shore installations and established training and testing areas. Even with introduction of the Undersea Warfare Training Range, these areas have not appreciably changed in the last decade and are not expected to change in the foreseeable future. Under Alternatives 1 and 2, the Study Area would be expanded from the No Action Alternative and the number of events may increase, but the concentration of vessel and in-water device use and the manner in which the Navy trains and tests would remain consistent with the range of variability observed over the last decade. This is partly because multiple activities occur from the same vessel platform. Therefore, the increased number of activities estimated for Alternatives 1 and 2 is not expected to result in an increase in vessel use or transit. 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 strikes are expected to occur is likely to remain consistent with the previous decade or be reduced because of the implementation of mitigation measures as outlined in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring). The difference in activities from the No Action Alternative to Alternative 1 and Alternative 2, shown in Table 3.0-36, is not likely to change the probability of a vessel strike in any meaningful way.

Training Activities

As indicated in Sections 3.0.5.3.3.1 (Vessels) and 3.0.5.3.3.2 (In-Water Devices), the majority of the training activities under all alternatives involve vessels, and a few of the activities involve the use of in-water devices. See Table 3.0-25 for a representative list of Navy vessel sizes and speeds and Table 3.0-37 for the types, sizes, and speeds of Navy in-water devices used in the Study Area. Figures 3.0-20 and 3.0-21 provide graphics that illustrate the location for the Preferred Alternative and the relative use of vessels in training and testing activities, respectively. These activities could be widely dispersed throughout the Study Area, but would be more concentrated near naval ports, piers and ranges. Navy training vessel traffic would be concentrated in the Northeast U.S. Continental Shelf Large Marine Ecosystem near Naval Station Norfolk in Norfolk, Virginia, and in the Southeast U.S. Continental Shelf Large Marine Ecosystem near Naval Station Mayport in Jacksonville, Florida. There is no seasonal differentiation in Navy vessel use. 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.

As indicated in Section 3.0.5.3.3.2 (In-Water Devices), training activities involving in-water devices occur in the Northeast, Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems, as well as the Gulf Stream Open Ocean Area—specifically within the Northeast, VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes and anywhere in the Gulf of Mexico. Use of in-water devices is concentrated within the VACAPES Range Complex. The number of in-water device activities increases by 75 percent under Alternative 1 and Alternative 2 compared to the No Action Alternative.

Species that do not occur near the surface within the Study Area—including all nine ESA-listed and proposed coral species and the ESA-candidate queen conch—would not be exposed to vessel strikes. Species that do occur near the surface within the Study Area would have the potential to be exposed to vessel strikes.

There is no overlap of vessels and in-water devices with designated critical habitat for elkhorn and staghorn coral (Sections 3.8.2.3.1 and 3.8.2.4.1, Status and Management) because vessels and in-water devices do not contact the seafloor during training and testing activities. Amphibious vehicles are an exception, but beaches are not critical habitat for elkhorn and staghorn coral (Sections 3.8.2.3.1 and 3.8.2.4.1, Status and Management). Therefore, vessels and in-water devices will not affect elkhorn and staghorn coral critical habitat.

Exposure of marine invertebrates to vessel disturbance and strikes is limited to organisms in the uppermost portions of the water column. Pelagic marine invertebrates are generally disturbed, rather than struck, as the water flows around the vessel or in-water device. Invertebrates that occur on the seafloor, including shallow-water corals, hard bottom, and deep-water corals, are not likely to be exposed to this stressor because they typically occur at depths greater than those potentially impacted by vessels.

The impact of vessels and in-water devices on marine invertebrates would be inconsequential because: (1) the area exposed to the stressor amounts to a small portion of each vessel's and in-water device's footprint, and is extremely small relative to most marine invertebrates' ranges, (2) the frequency of activities involving the stressor is low such that few individuals could be exposed to more than one event, and (3) exposures would be localized, temporary, and would cease with the conclusion of the activity. Activities involving vessels and in-water devices are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

Pursuant to the ESA, the use of vessels and in-water devices during training activities as described under the No Action Alternative, Alternative 1, or Alternative 2:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral;*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral; and*
- *will have no effect on elkhorn and staghorn coral critical habitat.*

Testing Activities

As indicated in Sections 3.0.5.3.3.1 (Vessels) and 3.0.5.3.3.2 (In-Water Devices), Navy testing vessel traffic would be concentrated near Naval Station Norfolk in Norfolk, Virginia, in the Northeast U.S. Continental Shelf Large Marine Ecosystem and Naval Station Mayport in Jacksonville, Florida in the Southeast U.S. Continental Shelf Large Marine Ecosystem.

As indicated in Section 3.0.5.3.3.2 (In-Water Devices), testing activities involving in-water devices are concentrated in the Gulf of Mexico and Northeast U.S. Continental Shelf Large Marine Ecosystems as well as the Gulf Stream Open Ocean Area—specifically within the Northeast and VACAPES Range Complexes and Naval Surface Warfare Center, Panama City Division Testing Range. The number of in-water device activities increases by approximately 123 percent under Alternative 1 and 146 percent under Alternative 2 compared to the No Action Alternative.

Species that do not occur near the surface within the Study Area—including all nine ESA-listed and proposed coral species, and the ESA-candidate queen conch—would not be exposed to vessel strikes. Species that do occur near the surface within the Study Area would have the potential to be exposed to vessel strikes.

There is no overlap in the use of vessels and in-water devices with designated critical habitat for elkhorn and staghorn coral (Sections 3.8.2.3.1 and 3.8.2.4.1, Status and Management) because vessels and in-water devices do not contact the seafloor during training and testing activities. Amphibious vehicles are an exception, but beaches are not critical habitat for elkhorn and staghorn coral (Sections 3.8.2.3.1 and 3.8.2.4.1, Status and Management). Therefore, vessels and in-water devices will not affect elkhorn and staghorn coral critical habitat.

There would be a higher likelihood of vessel strikes over the continental shelf portions of the Study Area because of the concentration of vessel movements in those areas. Exposure of marine invertebrates to vessel disturbance and strikes is limited to organisms in the uppermost portions of the water column. Pelagic marine invertebrates are generally disturbed, rather than struck, as the water flows around the vessel or in-water device. Invertebrates that occur on the seafloor, including shallow-water corals, hard bottom, and deep-water corals, are not likely to be exposed to this stressor because they typically occur at depths greater than that potentially impacted by vessels.

The impact of vessels and in-water devices on marine invertebrates would be inconsequential because: (1) the area exposed to the stressor amounts to a small portion of each vessel's and in-water device's footprint, and is extremely small relative to most marine invertebrates' ranges, (2) the frequency of activities involving the stressor is low such that few individuals could be exposed to more than one event, and (3) exposures would be localized, temporary, and would cease with the conclusion of the activity. Activities involving vessels and in-water devices are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

Pursuant to the ESA, the use of vessels and in-water devices during testing activities as described under the No Action Alternative, Alternative 1, or Alternative 2:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral;*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral; and*
- *will have no effect on elkhorn and staghorn coral critical habitat.*

3.8.3.3.1.2 Substressor Impacts on Sedentary Invertebrate Beds or Reefs as Essential Fish Habitat (Preferred Alternative)

Pursuant to the Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of vessels and in-water devices during training and testing activities will have no effect on sedentary invertebrate beds or reefs that constitute Essential Fish Habitat or Habitat Areas of Particular Concern (U.S. Department of the Navy 2013).

3.8.3.3.2 Impacts from Military Expended Materials

This section analyzes the strike potential to marine invertebrates of the following categories of military expended materials: (1) non-explosive practice munitions, (2) fragments from high-explosive munitions, and (3) expended materials other than munitions, such as sonobuoys, vessel hulks, and expendable targets. For a discussion of the types of activities that use military expended materials, where they are used, and how many activities would occur under each alternative, see Section 3.0.5.3.3.3 (Military Expended Material Strikes). Note that the analysis of all potential impacts (disturbance, strike, ingestion, and entanglement) of military expended materials on critical habitat is included in this section.

The spatial extent of military expended materials deposition includes all of the Study Area. Despite this broad range, the majority of military expended materials deposition occurs within established range complexes and testing ranges. Physical disturbance or strikes by military expended materials on marine invertebrates is possible at the water's surface, through the water column, and at the seafloor. Disturbance or strike impacts on marine invertebrates by military expended materials falling through the water column is possible, but not very likely because their kinetic energy dissipates within a few feet of the sea surface and they do not generally sink rapidly enough to cause strike injury. Exposed invertebrates would likely experience only temporary displacement as the object passes by. Therefore, the discussion of military expended materials disturbance and strikes will focus on military expended materials on the water's surface and the seafloor.

Sessile marine invertebrates and infauna (organisms attached to the seafloor or living in the seafloor sediments) are particularly susceptible to military expended material strike. This includes shallow-water corals, hard bottom, and deep-water corals. Physical disturbance and strikes on deep-water corals (both military expended materials and marine debris) were inferred during a recent mapping expedition where objects were observed resting on and near deep-water invertebrates (U.S. Department of the Navy 2009, 2011). Most shallow-water coral reefs in the Study Area are within or adjacent to the Key West Range Complex, where the greatest numbers of military expended materials are primarily lightweight flares and chaff, which have inconsequential strike potential. The organisms that define coral Habitat Areas of Particular Concern in other areas are susceptible and exposed to military expended materials strike and disturbance impacts.

Military expended materials may impact benthic invertebrate individuals, eggs, and larvae by disturbance, strike, burial, or abrasion of individuals at the site, and may disturb marine invertebrates outside the footprint of the military expended materials. Important physical and biological characteristics of ESA-listed elkhorn and staghorn coral critical habitat are defined in Sections 3.8.2.3.2 and 3.8.2.4.2 (Habitat and Geographic Range). These characteristics can be summarized as any hard substrate of suitable quality and availability to support settlement, recruitment, and attachment at depths from mean low water to 30 m within the organism's former geographic range (FR *73*(229): 72210-72241, November 26, 2008). Primary constituent elements were not formally defined for these species. Exemptions from critical habitat designations include a small zone around Naval Air Station Key West, and a small area within the South Florida Ocean Measurement Facility Testing Range (Sections 3.8.2.3.1 and 3.8.2.4.1, Status and Management). All activities using military expended materials in the Key West Range Complex and in waters shallower than 30 m in the South Florida Ocean Measurement Facility Testing Range could expose this substrate to disturbances that could degrade the quality of critical habitat.

Small-, Medium-, and Large-Caliber Projectiles. Various types of projectiles have the potential to cause a temporary localized impact when they strike the surface of the water. Navy training and testing in the Study Area, such as gunnery exercises, include firing a variety of weapons and use of a variety of non-explosive training and testing rounds.

Direct strike from firing or dropping munitions are potential stressors to marine invertebrates. Military expended materials have the potential to impact the water with great force. Physical disruption of the water column is a localized, temporary impact and would be limited to within tens of meters of the impact area, persisting for a matter of minutes. Physical and chemical properties of the surrounding water would be temporarily changed (e.g., slight heating or cooling and increased oxygen concentrations due to turbulent mixing with the atmosphere), but there would be no lasting change on the water resulting in long-term impacts on marine invertebrates. Although the sea surface is rich with invertebrates, most are zooplankton and relatively few are large pelagic invertebrates (e.g., some jellyfish and some swimming crabs). Zooplankton, eggs and larvae, and larger pelagic organisms in the upper portions of the water column could be displaced, injured, or killed by military expended materials impacting the sea surface. Potential indirect impacts of military expended materials are addressed in Section 3.8.3.6 (Secondary Stressors).

Marine invertebrate communities, eggs, and larvae on the seafloor throughout the Study Area would be exposed to munitions, including small-, medium-, and large-caliber projectiles. Marine invertebrates on the seafloor could be displaced, injured, or killed by military expended materials contacting the seafloor.

Potential impacts of projectiles to marine invertebrates on shallow-water corals, hard bottom, or deep-water corals present the greatest risk of long-term damage compared with other seafloor communities because: (1) many corals and hard bottom invertebrates are sessile, fragile, and particularly vulnerable; (2) many of these organisms are slow-growing and could require decades to recover (Precht et al. 2001); and (3) military expended materials are likely to remain mobile for a longer time because natural encrusting and burial processes are much slower on hard substrates than on soft bottom habitats.

Bombs, Missiles, and Rockets. Direct strike from bombs, missiles, and rockets are potential stressors to marine invertebrates. The nature of their potential impacts is the same as projectiles; however, they are addressed separately because their size in both non-explosive and high-explosive forms is greater than most projectiles and because high-explosive bombs, missiles, and rockets are likely to produce a greater number of small fragments than do projectiles. Propelled fragments are produced by high-explosives. Close to the explosion, invertebrates could potentially sustain injury from propelled fragments.

However, studies of underwater bomb blasts have shown that fragments are larger than those produced during air blasts and decelerate much more rapidly (O'Keefe and Young 1984; Swisdak Jr. and Montaro 1992), reducing the risk to marine organisms. Bombs, missiles, and rockets are designed to explode within 3 ft. (1 m) of the sea surface, where large marine invertebrates are relatively infrequent.

Vessel Hulk. During a sinking exercise, aircraft, ship, and submarine crews fire or drop munitions on a surface target, a clean (Section 3.1, Sediments and Water Quality) deactivated ship that is deliberately sunk using multiple weapon systems. Sinking exercises occur in specific open ocean areas, outside of the coastal range complexes, as shown in Figures 3.0-2 and 3.0-3. The analysis of sinking exercises as a strike potential for benthic invertebrates is discussed in terms of the ship hulk landing on the seafloor. The primary difference between a vessel hulk and other military expended materials as a strike potential for marine invertebrates is the difference of scale. As the vessel hulk settles on the seafloor, all marine invertebrates within the footprint of the hulk would be impacted by strike or burial, and invertebrates a short distance beyond the footprint of the hulk would be disturbed. It is likely that habitat-forming invertebrates are absent where sinking exercises are planned because this activity occurs in depths greater than the range of corals and most other habitat-forming invertebrates (approximately 3,000 m) and away from known hydrothermal vent communities.

Parachutes. Parachutes of varying sizes are used during training and testing activities. For a discussion of the types of activities that use parachutes, physical characteristics of these expended materials, where they are used, and how many activities would occur under each alternative, see Section 3.0.5.3.4.2 (Parachutes). Activities that expend sonobuoy and air-launched torpedo parachutes generally occur in water deeper than 183 m. Because they are in the air and water column for a time span of minutes (see Section 3.0.5.3.4.2, Parachutes), it is improbable that such a parachute deployed over water deeper than 183 m could travel far enough to affect shallow-water corals, including any of the nine ESA-listed or proposed coral species. Parachutes may impact marine invertebrates by disturbance, strikes, burial/smothering, or abrasion. Movement of parachutes in the water may break more fragile invertebrates such as deep-water corals.

3.8.3.3.2.1 No Action Alternative

Training Activities

As indicated in Section 3.0.5.3.3.3 (Military Expended Material Strikes), under the No Action Alternative, areas with the greatest amount of expended materials are expected to be the Northeast and Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems and the Gulf Stream Open Ocean Area—specifically within the Northeast, VACAPES, Navy Cherry Point, JAX, Key West, and GOMEX Range Complexes, and in the Gulf of Mexico and Other AFTT Areas. However, the largest potential impacted area from military expended materials occurs in Other AFTT Areas (sinking exercises) (Table 3.3-9).

Species that do not occur within these specified areas would not be exposed to military expended materials. Species that do occur within the areas listed above—including all nine ESA-listed and proposed coral species, and the ESA-candidate queen conch—would have the potential to be exposed to military expended materials. Human induced physical damage, such as exposure to military expended material strikes, was considered by NMFS to be a “negligible to low-importance” threat to coral species and was not cited as a factor when considering the ESA-listing of any coral species or the queen conch (Table 3.8-4 and Sections 3.8.2.3 Elkhorn Coral [*Acropora palmata*] to Section 3.8.2.12 Queen Conch [*Lobatus gigas*]).

All training activities involving military expended materials in the Key West Range Complex could expose substrate to disturbances that could degrade the quality, and potentially the quantity, of elkhorn and staghorn coral critical habitat (Sections 3.8.2.3.1 and 3.8.2.4.1, Status and Management). Exemptions from critical habitat designations include a small zone around Naval Air Station Key West (Sections 3.8.2.3.1 and 3.8.2.4.1, Status and Management). However, exposure is less likely to occur because mitigation measures, discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring), minimize potential impacts to the physical and biological characteristics of ESA-listed elkhorn and staghorn coral critical habitat. Military expended materials with the highest likelihood of overlap with elkhorn and staghorn coral critical habitat are chaff and flares, and these pose negligible risks to habitat. It is unlikely that training activities involving military expended materials would reduce the conservation value of elkhorn and staghorn coral critical habitat.

Military expended materials that are munitions (e.g., bombs, missiles, rockets, projectiles, and associated fragments) have the potential to directly strike marine invertebrates, zooplankton, eggs, and larvae at the sea surface and on the seafloor. Consequences of strike or disturbance could include injury or mortality, particularly within the footprint of the object as it contacts the seafloor. Individual organisms could be impacted directly or indirectly, but not to the extent that viability of populations or species would be impacted, primarily because the number of organisms exposed to these devices is extremely small relative to population sizes (see Table 3.3-9 for quantification of military expended material impact footprints).

Sinking exercises occur in open ocean areas, outside of the coastal range complexes, shown in Figures 3.0-2 and 3.0-3. Pelagic invertebrates present near the water's surface in the immediate vicinity of the exercise have the potential to be injured or killed. Vessel hulks contacting the seafloor would result in mortality of marine invertebrates within the footprint of the hulk and disturbance of marine invertebrates near the footprint of the hulk. Though the footprint of a vessel hulk is large relative to other military expended materials, the impacted area is extremely small relative to the spatial distribution of marine invertebrate populations. Habitat-forming invertebrates are likely to be absent where sinking exercises are planned (depths of approximately 3,000 m). Consequences of sinking exercises would impact individual organisms directly or indirectly, but not to the extent that viability of populations or species would be measurably impacted.

Activities occurring in the Key West Range Complex have the potential to impact shallow-water and deep-water corals, including all nine ESA-listed and proposed coral species. Because these organisms also constitute critical habitat, these same impacts could degrade habitat quality, and potentially quantity. Coral reefs along the continental U.S. are estimated to cover between 330 and 480 $mi.^2$ (850–1,250 km^2), most of which is within or adjacent to the Key West Range Complex (Section 3.8.2.15.1, Shallow-Water Coral). Mitigation measures described in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) would prohibit many military expended material-producing activities in shallow water near known shallow water coral reefs, including areas known to be inhabited by ESA-listed and ESA-proposed corals.

Activities occurring at depths of 650–2,600 ft. (200–800 m) have the potential to impact deep-water corals (Section 3.8.2.15.2, Deep-Water Corals). Activities in the Northeast U.S. Continental Shelf Large Marine Ecosystem in VACAPES Range Complex, and in the Southeast U.S. Continental Shelf Large Marine Ecosystem in Navy Cherry Point Range Complex and, particularly, the JAX Range Complex, have the potential to impact hard bottom and deep-water corals. Consequences could include breakage, injury, or mortality for each projectile or munition (Sections 3.8.2.15.2, Deep-Water Corals, and 3.3, Marine

Habitats). Parachutes could cause abrasion injury or mortality and breakage. Because these organisms are habitat-forming and also constitute some Habitat Areas of Particular Concern, these same impacts could degrade habitat quality. Individual organisms would be impacted directly or indirectly to the extent that viability of populations or species would be impacted (see Table 3.3-9 for quantification of military expended material footprints).

The impact of military expended materials on marine invertebrates is likely to cause injury or mortality to individual marine invertebrates—particularly soft-bodied organisms that are smaller than the military expended materials, but impacts to populations would be inconsequential because: (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges, (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one event, and (3) exposures would be localized and would cease when the military expended material stops moving. Activities involving military expended material are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level. However, the combined consequences of all military expended materials could degrade habitat quality.

For cases where potential impacts rise to the level that warrants mitigation, mitigation measures designed to minimize the potential impacts are discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring).

Pursuant to the ESA, the use of military expended materials during training activities as described under the No Action Alternative:

- *may affect but is not likely to adversely affect ESA-listed elkhorn coral or staghorn coral;*
- *may affect but is not likely to adversely affect ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral; and*
- *may affect but is not likely to adversely affect elkhorn and staghorn coral critical habitat.*

Testing Activities

As indicated in Section 3.0.5.3.3.3 (Military Expended Material Strikes), under the No Action Alternative, areas that involve the use of expended materials include the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems and the Gulf Stream Open Ocean Area—specifically within the Naval Surface Warfare Center, Panama City Division Testing Range; Northeast, VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes; and in the Other AFTT Areas. However, the largest potential impact footprint for military expended materials occurs in the VACAPES Range Complex (Table 3.3-10).

Species that do not occur within these specified areas would not be exposed to military expended materials. Species that do occur within the areas listed above—including all nine ESA-listed and proposed coral species, and the ESA-candidate queen conch—would have the potential to be exposed to military expended materials. Human-induced physical damage, such as exposure to military expended material strikes, was considered by NMFS to be a "negligible to low-importance" threat to coral species and was not cited as a factor when considering the ESA-listing of any coral species or the queen conch (Table 3.8-4 and Sections 3.8.2.3 Elkhorn Coral [*Acropora palmata*] to Section 3.8.2.12 Queen Conch [*Lobatus gigas*]).

A very low number of military expended materials may occur in the Key West Range Complex (Table 3.3-10), which also includes critical habitat designations for ESA-listed coral species. Exemptions from critical habitat designations include a small zone around Naval Air Station Key West (Sections 3.8.2.3.1 and 3.8.2.4.1, Status and Management).

Bombs, missiles, rockets, projectiles, torpedo (explosive) testing, and associated fragments have the potential to directly strike marine invertebrates, zooplankton, eggs, and larvae at the sea surface and at the seafloor. Consequences of strike or disturbance could include injury or mortality, particularly within the footprint of the object as it contacts the seafloor. Individual organisms would be impacted directly or indirectly, but not to the extent that viability of populations or species would be impacted, primarily because the number of organisms exposed to these devices is extremely small relative to population sizes (see Table 3.3-10) for quantification of military expended material impact footprints).

Activities occurring at depths of 200–800 m have the potential to impact deep-water corals. Activities occurring in the Northeast U.S. Continental Shelf Large Marine Ecosystem in VACAPES Range Complex, and in the Southeast U.S. Continental Shelf Large Marine Ecosystem in Navy Cherry Point Range Complex and, particularly, the JAX Range Complex have the potential to impact hard bottom and deep-water corals. Consequences could include breakage, injury, or mortality for each projectile, munition, or fragment (Sections 3.8.2.15.2, Deep-Water Corals, and 3.3, Marine Habitats). Parachutes could cause abrasion, injury, or mortality and breakage. Because these organisms are habitat-forming and also constitute some Habitat Areas of Particular Concern, these same impacts could degrade habitat quality.

The impact of military expended materials on marine invertebrates is likely to cause injury or mortality to individual marine invertebrates—particularly soft-bodied organisms that are smaller than the military expended materials, but impacts to populations would be inconsequential because: (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges, (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one event, and (3) exposures would be localized and would cease when the military expended material stops moving. Activities involving military expended materials are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level. However, the combined consequences of all military expended materials could degrade habitat quality (see Table 3.3-10 for quantification of military expended material impact footprints).

Mitigation measures designed to minimize the potential impacts to seafloor resources including shallow coral reefs, are discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring).

Pursuant to the ESA, the use of military expended materials during testing activities as described under the No Action Alternative:

- *may affect but is not likely to adversely affect ESA-listed elkhorn coral or staghorn coral;*
- *may affect but is not likely to adversely affect ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral; and*
- *may affect but is not likely to adversely affect elkhorn and staghorn coral critical habitat.*

3.8.3.3.2.2 Alternative 1

Training Activities

As indicated in Section 3.0.5.3.3.3 (Military Expended Material Strikes), under Alternative 1 the total amount of military expended materials is more than twice the amount expended in the No Action Alternative, most of which are small- and medium-caliber projectiles. However, the potential impacted area from military expended materials actually declines from the No Action Alternative due to a reduction in the number of sinking exercises that expend ship hulks (Table 3.3-11). The activities under Alternative 1 would occur in the same geographic locations with the same types of expended materials in the same relative dimensions (excluding sinking exercises) as the No Action Alternative.

Species that do not occur within these specified areas would not be exposed to military expended materials. Species that do occur within the areas listed above—including any of the nine ESA-listed or proposed coral species, and the ESA-candidate queen conch—would have the potential to be exposed to military expended materials. As under the No Action Alternative, military expended materials may affect critical habitat for elkhorn and staghorn coral. Human induced physical damage, such as exposure to military expended material strikes, was considered by NMFS to be a "negligible to low-importance" threat to coral species and was not cited as a factor when considering the ESA-listing of any coral species or the queen conch (Table 3.8-4 and Sections 3.8.2.3 Elkhorn Coral [*Acropora palmata*] to Section 3.8.2.12 Queen Conch [*Lobatus gigas*]).

Sinking exercises occur in open ocean areas, outside of the coastal range complexes, shown in Figures 3.0-2 and 3.0-3, and vessel hulks contacting the seafloor would result in mortality of marine invertebrates within the footprint of the hulk and disturbance of marine invertebrates near the footprint of the hulk. Consequences are identical to the No Action Alternative, but reduced to only one event.

Activities occurring in the Key West Range Complex have the potential to impact shallow-water and deep-water corals, including all nine ESA-listed or proposed coral species. Coral reefs along the continental United States are estimated to cover between 330 and 480 $mi.^2$ (850-1,250 km^2), most of which is within or adjacent to the Key West Range Complex (Section 3.8.2.9.1, Shallow-Water Coral). It is possible that parachutes could overlap with coral reefs in this region; however it is unlikely since they are generally expended in water deeper than 600 ft. (183 m) and would most likely not travel far enough to impact shallow-water species.

Also, activities occurring at depths of 200–800 m in the VACAPES Range Complex, Navy Cherry Point Range Complex and, particularly, the JAX Range Complex have the potential to impact hard bottom and deep-water corals. The differences in species overlap and potential impacts from military expended material strikes on marine invertebrates and ESA-listed or -proposed coral species during training activities would not be discernible from those described for training activities in Section 3.8.3.3.2.1 (No Action Alternative).

As discussed in Section 3.8.3.3.2.1 (No Action Alternative), impact of military expended materials on marine invertebrates is likely to cause injury or mortality to individuals, eggs, and larvae at the sea surface and at the seafloor—particularly soft-bodied organisms that are smaller than the military expended materials—but impacts to populations would be inconsequential. Considering the increase in activities in previously identified locations, the potential impacts remain inconsequential for the reasons discussed under the No Action Alternative (Section 3.8.3.3.2.1, No Action Alternative). Similarly, the use of military expended materials would not reduce the conservation value of critical habitat for elkhorn coral or staghorn coral for reasons stated in Section 3.8.3.3.2.1 (No Action Alternative). Activities involving military expended materials are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

Mitigation measures designed to minimize the potential impacts to seafloor resources including shallow coral reefs, are discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring).

Pursuant to the ESA, the use of military expended materials during training activities as described under Alternative 1:

- *may affect but is not likely to adversely affect ESA-listed elkhorn coral or staghorn coral;*
- *may affect but is not likely to adversely affect ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral; and*
- *may affect but is not likely to adversely affect elkhorn and staghorn coral critical habitat.*

Testing Activities

As indicated in Section 3.0.5.3.3.3 (Military Expended Material Strikes), under Alternative 1 the total amount of military expended materials is nearly four times greater than the amount expended in the No Action Alternative. Activities under Alternative 1 would occur in the same geographic locations using the same types of military expended materials as the No Action Alternative, with the addition of the South Florida Ocean Measurement Facility Testing Range. Based on the potential impacted area from military expended materials, there is a decline in the VACAPES Range Complex and corresponding increase in the JAX and Navy Cherry Point Range Complexes (Table 3.3-12), compared to the No Action Alternative.

Species that do not occur within these specified areas would not be exposed to military expended materials. Species that do occur within the areas listed above—including all nine ESA-listed or proposed coral species, and the ESA-candidate queen conch—would have the potential to be exposed to military expended materials. Activities occurring in Other AFTT Areas or anywhere in the AFTT Study Area could overlap with ESA-listed elkhorn and staghorn coral and their critical habitat. All nine ESA-listed and ESA-proposed coral species occur within the South Florida Ocean Measurement Facility Testing Range. Human-induced physical damage, such as exposure to military expended material strikes, was considered by NMFS to be a "negligible to low-importance" threat to coral species and was not cited as a factor when considering the ESA-listing of any coral species or the queen conch (Table 3.8-4 and Sections 3.8.2.3 Elkhorn Coral [*Acropora palmata*] to Section 3.8.2.12 Queen Conch [*Lobatus gigas*]).

All testing activities involving military expended materials in both the Key West Range Complex and the South Florida Ocean Measurement Facility Testing Range could expose substrate to disturbances that could degrade the quality of elkhorn and staghorn coral critical habitat (Sections 3.8.2.3.1 and 3.8.2.4.1, Status and Management). While critical habitat for staghorn and elkhorn coral has been designated within part of the shallow (less than 30 m) nearshore portion of the South Florida Ocean Measurement Facility Testing Range (Sections 3.8.2.3.1 and 3.8.2.4.1, Status and Management), testing activities that involve the use of military expended materials occur offshore of these areas within the Training Minefield Operating Area, which ranges in depth from approximately 230–280 m. Exemptions from critical habitat designations include a small zone around Naval Air Station Key West and a small area within the South Florida Ocean Measurement Facility Testing Range (Sections 3.8.2.3.1 and 3.8.2.4.1, Status and Management).

Activities occurring in the Key West Range Complex have the potential to impact shallow-water and deep-water corals, including all nine ESA-listed and proposed coral species. Coral reefs along the continental United States are estimated to cover between 330 and 480 $mi.^2$ (850–1,250 km^2), most of which is within or adjacent to the Key West Range Complex (Section 3.8.2.9.1, Shallow-Water Coral). It is possible that parachutes could overlap with coral reefs in this region; however it is unlikely since they are generally expended in water deeper than 600 ft. (183 m) and would most likely not travel far enough to impact shallow-water species. As described under the No Action Alternative, military expended materials may affect critical habitat for elkhorn and staghorn coral in the Key West Range Complex. However, exposure is less likely to occur because mitigation measures, discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring), minimize potential impacts to the physical and biological characteristics of ESA-listed elkhorn and staghorn coral critical habitat. Therefore, it is unlikely that testing activities involving military expended materials within the Key West Range Complex would reduce the conservation value of elkhorn and staghorn coral critical habitat.

Testing activities occurring in the South Florida Ocean Measurement Facility Testing Range have the potential to impact shallow-water and deep-water corals, including all nine ESA-listed and proposed coral species. Military expended materials utilized within the South Florida Ocean Measurement Facility Testing Range are limited to anchor blocks used to moor minefield targets and shapes. Deployment of the anchor blocks is conducted using real-time Geographic Information System (GIS) and global positioning system (GPS), along with groundtruth and verification support, which will help the Navy avoid sensitive marine species and communities during deployment, installation, and recovery. At the conclusion of the testing event, the minefield targets and shapes are typically recovered. Mitigation measures specific to South Florida Ocean Measurement Facility Testing Range that are designed to minimize the potential impacts to seafloor resources, including shallow coral reefs, are discussed in Chapter 5. Also, activities occurring at depths of 200–800 m in the VACAPES Range Complex, Navy Cherry Point Range Complex, and particularly the JAX Range Complex have the potential to impact hard bottom and deep-water corals. The differences in species overlap and potential impacts from military expended material strikes on marine invertebrates and ESA-listed or proposed coral species during testing activities would not be discernible from those described for testing activities in Section 3.8.3.3.2.1 (No Action Alternative).

As discussed in Section 3.8.3.3.2.1 (No Action Alternative), impact of military expended materials on marine invertebrates is likely to cause injury or mortality to individuals, eggs, and larvae at the sea surface and at the seafloor, but impacts to populations would be inconsequential. Considering the increase in activities in previously identified locations and the addition of new locations, the potential impacts remain inconsequential for the reasons discussed under the No Action Alternative (Section 3.8.3.3.2.1, No Action Alternative). Similarly, the use of military expended materials would not reduce the conservation value of critical habitat for elkhorn coral or staghorn coral within the Key West Range Complex for reasons stated in Section 3.8.3.3.2.1 (No Action Alternative). For critical habitat designated within the confines of the South Florida Ocean Measurement Facility Testing Range, the use of military expended materials is not likely to reduce the conservation value of critical habitat for elkhorn coral or staghorn coral due to mitigation measures discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring).

Individual organisms would be impacted directly or indirectly, but not to the extent that viability of populations or species would be impacted. However, the combined consequences of all military expended materials could degrade habitat quality (see Table 3.3-12 for quantification of military expended material impact footprints). Mitigation measures designed to minimize the potential impacts to seafloor resources including shallow coral reefs, are discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring).

Pursuant to the ESA, the use of military expended materials during testing activities as described under Alternative 1:

- *may affect but is not likely to adversely affect ESA-listed elkhorn coral or staghorn coral;*
- *may affect but is not likely to adversely affect ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral; and*
- *may affect but is not likely to adversely affect elkhorn coral and staghorn coral critical habitat.*

3.8.3.3.2.3 Alternative 2 (Preferred Alternative)

Training Activities

The number and location of training activities under Alternative 2 are identical to training activities under Alternative 1. Therefore, impacts and comparisons to the No Action Alternative will also be identical as described in Section 3.8.3.3.2.2 (Alternative 1).

Testing Activities

As indicated in Section 3.0.5.3.3.3 (Military Expended Material Strikes), under Alternative 2 the total amount of military expended materials is nearly four times the amount expended in the No Action Alternative, but only increases by 5 percent as compared to Alternative 1. The activities under Alternative 2 would occur in the same geographic locations using the same types of military expended materials and will have the same relative potential impact area as Alternative 1 (Table 3.3-13).

Species that do not occur within these specified areas would not be exposed to military expended materials. Species that do occur within the areas listed above—including all nine ESA-listed and proposed coral species, and the ESA-candidate queen conch—would have the potential to be exposed to military expended materials. Activities occurring in Other AFTT Areas and anywhere in the AFTT Study Area could overlap with ESA-listed elkhorn and staghorn coral and their critical habitat. As under Alternative 1, human induced physical damage, such as exposure to military expended material strikes, was considered by NMFS to be a "negligible to low-importance" threat to coral species and was not cited as a factor when considering the ESA-listing of any coral species or the queen conch (Table 3.8-4 and Sections 3.8.2.3 Elkhorn Coral [*Acropora palmata*] to Section 3.8.2.12 Queen Conch [*Lobatus gigas*]). As under Alternative 1, military expended materials may affect critical habitat for elkhorn and staghorn coral.

The differences in species overlap and potential impacts from military expended material strikes on marine invertebrates and ESA-listed or -proposed coral species during testing activities would not be discernible from those described for testing activities in Section 3.8.3.3.2.2 (Alternative 1).

Activities occurring in the Key West Range Complex have the potential to impact shallow-water and deep-water corals, including all nine ESA-listed or proposed coral species. Coral reefs along the continental United States are estimated to cover between 330 and 480 $mi.^2$ (850–1,250 km^2), most of which is within or adjacent to the Key West Range Complex (Section 3.8.2.15.1, Shallow-Water Coral). It is possible that parachutes could overlap with coral reefs in this region; however it is unlikely since they are generally expended in water deeper than 600 ft. (183 m) and would most likely not travel far enough to impact shallow-water species. Similarly, the use of military expended materials within the Key West

Range Complex is not expected to reduce the conservation value of critical habitat for elkhorn coral or staghorn coral for reasons stated in Section 3.8.3.3.2.2 (Alternative 1).

Testing activities occurring in the South Florida Ocean Measurement Facility Testing Range have the potential to impact shallow-water and deep-water corals, including all nine ESA-listed and proposed coral species. Military expended materials utilized within the South Florida Ocean Measurement Facility Testing Range are limited to anchor blocks used to moor minefield targets and shapes. Deployment of the anchor blocks is conducted using real-time Geographic Information System (GIS) and global positioning system (GPS), along with groundtruth and verification support, which will help the Navy avoid sensitive marine species and communities during deployment, installation, and recovery. At the conclusion of the testing event, the minefield targets and shapes are typically recovered. Mitigation measures specific to South Florida Ocean Measurement Facility Testing Range that are designed to minimize the potential impacts to seafloor resources including shallow coral reefs, are discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring).

Also, activities occurring at depths of 200–800 m in the VACAPES Range Complex, Navy Cherry Point Range Complex, and particularly the JAX Range Complex have the potential to impact hard bottom and deep-water corals. The differences in species overlap and potential impacts from military expended material strikes on marine invertebrates and ESA-listed or -proposed coral species during testing activities would not be discernible from those described for testing activities in Section 3.8.3.3.2.1 (No Action Alternative).

As discussed in Section 3.8.3.3.2.1 (No Action Alternative), impact of military expended materials on marine invertebrates is likely to cause injury or mortality to individuals, eggs, and larvae at the sea surface and at the seafloor, but impacts to populations would be inconsequential. Considering the increase in activities in previously identified locations and the addition of new locations, the potential impacts remain inconsequential for the reasons discussed under the No Action Alternative (Section 3.8.3.3.2.1, No Action Alternative). Similarly, the use of military expended materials would not reduce the conservation value of critical habitat for elkhorn coral or staghorn coral within the Key West Range Complex for reasons stated in Section 3.8.3.3.2.1 (No Action Alternative). For critical habitat designated within the confines of the South Florida Ocean Measurement Facility Testing Range, the use of military expended materials is not likely to reduce the conservation value of critical habitat for elkhorn coral or staghorn coral due to mitigation measures discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring).

Activities involving military expended materials are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level. However, the combined consequences of all military expended materials could degrade habitat quality (see Table 3.3-13 for quantification of military expended material impact footprints). Mitigation measures designed to minimize the potential impacts to seafloor resources including shallow coral reefs, are discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring).

Pursuant to the ESA, the use of military expended materials during testing activities as described under Alternative 2:

- *may affect but is not likely to adversely affect ESA-listed elkhorn coral or staghorn coral;*
- *may affect but is not likely to adversely affect ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral; and*
- *may affect but is not likely to adversely affect elkhorn and staghorn coral critical habitat.*

3.8.3.3.2.4 Substressor Impacts on Sedentary Invertebrate Beds or Reefs as Essential Fish Habitat (Preferred Alternative)

Pursuant to the Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of military expended materials during training and testing activities may have an adverse effect on Essential Fish Habitat by reducing the quality or quantity of sedentary invertebrate beds or reefs that constitute Essential Fish Habitat or Habitat Areas of Particular Concern (U.S. Department of the Navy 2013). The AFTT Essential Fish Habitat Assessment states that the impact to sedentary invertebrate beds would be minimal and long-term to permanent in duration (based on substrate impacts), whereas impacts to reefs would be individually minimal and permanent in duration (U.S. Department of the Navy 2013).

3.8.3.3.3 Impacts from Seafloor Devices

For a discussion of the types of activities that use seafloor devices, where they are used, and how many activities would occur under each alternative, see Sections 3.0.5.3.3.4 (Seafloor Devices) and Section 3.3.3.2.2 (Seafloor Devices). These include items that are placed on, dropped on, or moved along the seafloor such as mine shapes, anchor blocks, anchors, bottom-placed instruments, bottom-crawling unmanned underwater vehicles, and bottom placed targets that are recovered (not expended).

Placement or mooring of objects on the seafloor may impact benthic invertebrates, eggs, and larvae by disturbance, strike, burial, or abrasion of individuals at the site and may disturb marine invertebrates outside the footprint of the seafloor device. Important physical and biological characteristics of ESA-listed elkhorn and staghorn coral critical habitat are defined in Sections 3.8.2.3.2 and 3.8.2.4.2 (Habitat and Geographic Range). These characteristics can be summarized as any hard substrate of suitable quality and availability to support settlement, recruitment, and attachment at depths from mean low water to 30 m within the organism's former geographic range (FR 73(229): 72210-72241, November 26, 2008). Primary constituent elements were not formally defined for these species. Exemptions from critical habitat designations include a small zone around Naval Air Station Key West, and a small area within the South Florida Ocean Measurement Facility Testing Range (Sections 3.8.2.3.1 and 3.8.2.4.1, Status and Management). All activities using seafloor devices in the Key West Range Complex and the South Florida Ocean Measurement Facility Testing Range could expose this substrate to disturbances that could degrade the quality of critical habitat.

Precision anchoring is qualitatively different and potential impacts to the seafloor are more intense than for other seafloor devices. The training activity involves navigation to a preplanned position and deployment of the ship's anchor. The ship's crew is evaluated on the accuracy of the ship's position after the anchor is deployed. Precision anchoring may result in short-term and localized disturbances to water column habitats and long-term disturbances to seafloor habitats. Bottom sediments would be disturbed, and localized increases in turbidity would occur when an anchor makes contact with the seafloor, but turbidity would quickly dissipate (i.e., time scales of minutes to hours) following the exercise. Seafloor habitat and associated marine invertebrates in designated anchorage areas are likely prevented from fully recovering due to long-term, historical use of the same areas for anchoring.

3.8.3.3.3.1 No Action Alternative

Training Activities

As indicated in Section 3.0.5.3.3.4 (Seafloor Devices), under the No Action Alternative, seafloor devices occur in the Northeast and Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems, as well as Gulf Stream Open Ocean Area—specifically within the VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes.

Species that do not occur within these specified areas—including all nine ESA-listed or proposed coral species—would not be exposed to seafloor devices. Species that do occur within the areas listed above—including the ESA-candidate queen conch—would have the potential to be exposed to seafloor devices.

No activities occur in southern Florida or the Key West Range Complex. Therefore, there would be no impact on elkhorn and staghorn coral critical habitat under the No Action Alternative.

Activities occurring at depths less than 800 m have the potential to impact hard bottom or deep-water corals. Activities in the VACAPES Range Complex, Navy Cherry Point Range Complex, and particularly the JAX Range Complex have the potential to impact hard bottom and deep-water corals (Sections 3.8.2.15.2, Deep-Water Corals; 3.8.2.15.3, Hard Bottom; and 3.3, Marine Habitats). Consequences could include breakage, injury, or mortality for each device, mooring, or anchor.

Potential impacts of precision anchoring are qualitatively different from other seafloor devices because the activity involves repeated disturbance to the same area of seafloor. Precision anchoring occurs in long-established soft-bottom areas that have a history of disturbance by anchors, and continued exposure is likely to be inconsequential and not detectable.

The impact of seafloor devices on marine invertebrates is likely to cause injury or mortality to individuals, but impacts to populations would be inconsequential because: (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges, (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one event, and (3) exposures would be localized. Activities involving seafloor devices are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level.

Pursuant to the ESA, the use of seafloor devices during training activities as described under the No Action Alternative:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral;*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral; and*
- *will have no effect on elkhorn and staghorn coral critical habitat.*

Testing Activities

As indicated in Section 3.0.5.3.3.4 (Seafloor Devices), under the No Action Alternative the use of seafloor devices occurs in the Gulf of Mexico, Northeast, and Southeast U.S. Continental Shelf Large Marine

Ecosystems as well as Gulf Stream Open Ocean Area—specifically within the VACAPES Range Complex, Naval Undersea Warfare Center Division, Newport Testing Range, Naval Surface Warfare Center, Panama City Division Testing Range, and nearshore locations at Newport, Rhode Island and Joint Expeditionary Base Little Creek, Virginia Beach, Virginia.

Species that do not occur within these specified areas would not be exposed to seafloor devices. Species that do occur within the areas listed above—including all nine ESA-listed or proposed coral species, and the ESA-candidate queen conch—would have the potential to be exposed to seafloor devices. Human-induced physical damage, such as exposure to seafloor devices, was considered by NMFS to be a “negligible to low-importance” threat to coral species and was not cited as a factor when considering the ESA-listing of any coral species or the queen conch (Table 3.8-4 and Sections 3.8.2.3 Elkhorn Coral [*Acropora palmata*] to Section 3.8.2.12 Queen Conch [*Lobatus gigas*]).

Benthic organisms would be exposed to strike and disturbance in the relatively small area transited by bottom-crawling unmanned underwater vehicles. Potential consequences of a strike by bottom-crawling unmanned underwater vehicles would be dependent upon the type of benthic invertebrate encountered. Within the Naval Undersea Warfare Center Division, Newport Testing Range and the Naval Surface Warfare Center, Panama City Division Testing Range where primarily soft bottom habitats are present, impacts to benthic invertebrates are unlikely to be greater than consequences of disturbance because the pressure exerted by the unmanned underwater vehicle is so little. The largest unmanned underwater vehicle weighs 92 lb. (42 kg) and has a footprint of 4.8 $ft.^2$ (0.45 m^2). Assuming, worst case, that the unmanned underwater vehicle's buoyant weight is 92 lb., it exerts a pressure of only 0.133 pounds per square inch (PSI) (917 Pa). Few benthic marine invertebrates would be injured by such little pressure, particularly over soft sediments which would compress under the invertebrate and relieve some of the pressure being exerted by the weight of the crawler.

Activities occurring at depths less than 800 m have the potential to impact hard bottom and deep-water corals (with the exception of VACAPES W-50). Activities in the VACAPES Range Complex, Navy Cherry Point Range Complex, and particularly the JAX Range Complex have the potential to impact hard bottom and deep-water corals (Sections 3.8.2.15.2, Deep-Water Corals; 3.8.2.15.3, Hard Bottom; and 3.3, Marine Habitats).

Activities involving seafloor devices are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at the population level—including ESA-listed or proposed species.

Pursuant to the ESA, the use of seafloor devices during testing activities as described under the No Action Alternative:

- *may affect but is not likely to adversely affect ESA-listed elkhorn coral or staghorn coral;*
- *may affect but is not likely to adversely affect ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck’s sheet coral; and*
- *will have no effect on elkhorn and staghorn coral critical habitat.*

3.8.3.3.3.2 Alternative 1

Training Activities

As indicated in Section 3.0.5.3.3.4 (Seafloor Devices), under Alternative 1 the number of activities using seafloor devices is 44 percent more than that of the No Action Alternative. Activities using seafloor devices under Alternative 1 would occur in the same geographic locations as the No Action Alternative, with the exception of introducing seafloor devices in the following bays or inland waters: Sandy Hook Bay, Earle, New Jersey; lower Chesapeake Bay, Hampton Roads, Virginia; Beaufort Inlet Channel, Morehead City, North Carolina; Cape Fear River, Wilmington, North Carolina; St. Andrew Bay, Panama City, Florida; Sabine Lake, Beaumont, Texas; and Corpus Christi Bay, Corpus Christi, Texas.

Species that do not occur within these specified areas—including all nine ESA-listed or proposed coral species—would not be exposed to seafloor devices. Species that do occur within the areas listed above—including the ESA-candidate queen conch—would have the potential to be exposed to seafloor devices.

No activities occur in southern Florida or the Key West Range Complex. Therefore, there would be no impact on elkhorn and staghorn coral critical habitat.

As stated in Section 3.8.3.3.3.1 (No Action Alternative), seafloor devices are not expected to result in impacts to the viability of populations or species of marine invertebrates—including ESA-listed or proposed species. There is no overlap between activities and shallow-water corals or elkhorn and staghorn coral critical habitat. In comparison to the No Action Alternative, the increase in activities does not substantially increase the risk of exposure to seafloor devices. The impact of seafloor devices on marine invertebrates is likely to cause injury or mortality to individuals, but impacts to populations would be inconsequential for the reasons described in the No Action Alternative.

Pursuant to the ESA, the use of seafloor devices during training activities as described under Alternative 1:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral;*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral; and*
- *will have no effect on elkhorn and staghorn coral critical habitat.*

Testing Activities

As indicated in Section 3.0.5.3.3.4 (Seafloor Devices), under Alternative 1 the number of activities using seafloor devices is approximately twice that of the No Action Alternative. New activities proposed under Alternative 1 include the use of bottom crawling unmanned underwater vehicles within the South Florida Ocean Measurement Facility Testing Range. Activities using seafloor devices under Alternative 1 would be undertaken in the same geographic locations as the No Action Alternative in addition to the South Florida Ocean Measurement Facility Testing Range; Northeast, Navy Cherry Point, and JAX Range Complexes; and anywhere in the Gulf of Mexico.

Species that do not occur within these specified areas would not be exposed to seafloor devices. Species that do occur within the areas listed above—including all nine ESA-listed or proposed coral species, and the ESA-candidate queen conch—would have the potential to be exposed to seafloor devices. All nine of the ESA-listed and ESA-proposed coral species occur within the South Florida Ocean Measurement Facility Training Range (Gilliam and Walker 2011). Human-induced physical damage, such as exposure to seafloor devices, was considered by NMFS to be a "negligible to low-importance" threat to coral species and was not cited as a factor when considering the ESA-listing of any coral species or the queen conch (Table 3.8-4 and Sections 3.8.2.3 Elkhorn Coral [*Acropora palmata*] to Section 3.8.2.12 Queen Conch [*Lobatus gigas*]).

Testing activities involving the use of anchor blocks, used to moor minefield targets and shapes, that are deployed and recovered within the South Florida Ocean Measurement Facility Testing Range have the potential to impact shallow-water and deep-water corals, including all nine ESA-listed and proposed coral species. Deployment of the anchor blocks is conducted using real-time Geographic Information System (GIS) and global positioning system (GPS), along with groundtruth and verification support, which will help the Navy avoid sensitive marine species and communities during deployment, installation, and recovery. At the conclusion of the testing event, the minefield targets and shapes are typically recovered, but may be left in place. Mitigation measures specific to South Florida Ocean Measurement Facility Testing Range that are designed to minimize the potential impacts to seafloor resources including shallow coral reefs, are discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring).

While critical habitat for staghorn and elkhorn coral has been designated within part of the shallow (less than 30 m) nearshore portion of the South Florida Ocean Measurement Facility Testing Range (Sections 3.8.2.3.1 and 3.8.2.4.1, Status and Management), testing activities that involve the use of seafloor devices, in this case the deployment and recovery of anchor blocks, mainly occur offshore of these areas within the Training Minefield Operating Area, which ranges in depth from approximately 230–280 m (754.6–918.6 ft.). Furthermore, the use of seafloor devices is not likely to reduce the conservation value of critical habitat for elkhorn coral or staghorn coral due to mitigation measures discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring).

Testing activities involving the use of bottom crawling unmanned underwater vehicles within the South Florida Ocean Measurement Facility Testing Range would be limited to the Port Everglades Restricted Anchorage Area (Section 2.1.6.2, Sea and Undersea Space). Deployment of the bottom crawling unmanned underwater vehicles would mainly occur in waters less than 9.8 ft. (3 m) in depth. However, if deployment is necessary deeper than 9.8 ft. (3 m), it will be conducted using real-time Geographic Information System (GIS) and global positioning system (GPS), along with groundtruth and verification support, which will help the Navy avoid sensitive marine species and communities. Mitigation measures specific to South Florida Ocean Measurement Facility Testing Range that are designed to minimize the potential impacts to seafloor resources including shallow coral reefs, are discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring). This specific area within the South Florida Ocean Measurement Facility Testing Range is exempted from designation of critical habitat for elkhorn and staghorn coral. However, the area does contain all nine ESA-listed and proposed coral species which may potentially be impacted by the use of crawlers during testing activities within the range.

Seafloor devices are not expected to result in impacts to the viability of populations or species of marine invertebrates—including ESA-listed or proposed species. In comparison to the No Action Alternative, the increase in activities does not substantially increase the risk of exposure to seafloor devices. As described in the No Action Alternative, the fitness of individual organisms would not be impacted directly or indirectly to the extent that viability of populations or species could be impacted because the areas exposed to these devices are extremely small relative to population sizes.

Pursuant to the ESA, the use of seafloor devices during testing activities as described under Alternative 1:

- *may affect but is not likely to adversely affect ESA-listed elkhorn coral or staghorn coral;*
- *may affect but is not likely to adversely affect ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral; and*
- *may affect but is not likely to adversely affect elkhorn and staghorn coral critical habitat.*

3.8.3.3.3.3 Alternative 2 (Preferred Alternative)

Training Activities

The number and location of training activities under Alternative 2 are identical to training activities under Alternative 1. Therefore, impacts and comparisons to the No Action Alternative will also be identical as described in Section 3.8.3.3.3.2 (Alternative 1).

Testing Activities

As indicated in Section 3.0.5.3.3.4 (Seafloor Devices), under Alternative 2 the number of activities using seafloor devices is approximately twice that of the No Action Alternative and Alternative 1. Activities using seafloor devices under Alternative 2 would be undertaken in the same geographic locations as the No Action Alternative, in addition to the Northeast, Navy Cherry Point, and JAX Range Complexes and anywhere in the Gulf of Mexico.

Species that do not occur within these specified areas would not be exposed to seafloor devices. Species that do occur within the areas listed above—including all nine ESA-listed or proposed coral species, and the ESA-candidate queen conch—would have the potential to be exposed to seafloor devices. Activities could overlap with ESA-listed or proposed coral when they occur in the South Florida Ocean Measurement Facility Testing Range. All nine of the ESA-listed and ESA-proposed coral species occur within the South Florida Ocean Measurement Facility Training Range. Human-induced physical damage, such as exposure to seafloor devices, was considered by NMFS to be a "negligible to low-importance" threat to coral species and was not cited as a factor when considering the ESA-listing of any coral species or the queen conch (Table 3.8-4 and Sections 3.8.2.3 Elkhorn Coral [*Acropora palmata*] to Section 3.8.2.12 Queen Conch [*Lobatus gigas*]).

Testing activities involving the use of anchor blocks, used to moor minefield targets and shapes, that are deployed and recovered within the South Florida Ocean Measurement Facility Testing Range have the potential to impact shallow-water and deep-water corals, including all nine ESA-listed and proposed coral species. Deployment of the anchor blocks is conducted using real-time Geographic Information System (GIS) and global positioning system (GPS), along with groundtruth and verification support, which will help the Navy avoid sensitive marine species and communities during deployment, installation, and recovery. At the conclusion of the testing event, the minefield targets and shapes are typically recovered, but may be left in place. Mitigation measures specific to South Florida Ocean Measurement Facility Testing Range that are designed to minimize the potential impacts to seafloor resources including shallow coral reefs, are discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring). For critical habitat designated within the confines of the South Florida Ocean Measurement Facility Testing Range, the use of seafloor devices is not likely to reduce the conservation value of critical habitat for elkhorn coral or staghorn coral due to mitigation measures discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring).

Testing activities involving the use of bottom crawling unmanned underwater vehicles within the South Florida Ocean Measurement Facility Testing Range would be limited to the Port Everglades Restricted Anchorage Area (Section 2.1.6.2, Sea and Undersea Space). Deployment of the bottom crawling unmanned underwater vehicles would mainly occur in waters less than 9.8 ft. (3 m) in depth. However, if deployment is necessary deeper than 9.8 ft. (3 m), it will be conducted using real-time Geographic Information System (GIS) and global positioning system (GPS), along with groundtruth and verification support, which will help the Navy avoid sensitive marine species and communities. Mitigation measures specific to South Florida Ocean Measurement Facility Testing Range that are designed to minimize the potential impacts to seafloor resources including shallow coral reefs, are discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring). This specific area within the South Florida Ocean Measurement Facility Testing Range is exempted from designation of critical habitat for elkhorn and staghorn coral. However, the area does contain all nine ESA-listed and proposed coral species which may potentially be impacted by the use of crawlers during testing activities within the range.

As stated in Section 3.8.3.3.3.2 (Alternative 1), seafloor devices are not expected to result in impacts to the viability of populations or species of marine invertebrates—including ESA-listed or proposed species. In comparison to the No Action Alternative, the increase in activities does not substantially increase the risk of exposure to seafloor devices. As described in the No Action Alternative, the fitness of individual organisms would not be impacted directly or indirectly to the extent that viability of populations or species could be impacted because the areas exposed to these devices are extremely small relative to population sizes.

Pursuant to the ESA, the use of seafloor devices during testing activities as described under Alternative 2:

- *may affect but is not likely to adversely affect ESA-listed elkhorn coral or staghorn coral;*
- *may affect but is not likely to adversely affect ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral; and*
- *may affect but is not likely to adversely affect elkhorn and staghorn coral critical habitat.*

3.8.3.3.3.4 Substressor Impacts on Sedentary Invertebrate Beds or Reefs as Essential Fish Habitats (Preferred Alternative)

Pursuant to the Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of seafloor devices during training and testing activities could have an adverse effect on sedentary invertebrate beds or reefs that constitute Essential Fish Habitat or Habitat Areas of Particular Concern (U.S. Department of the Navy 2013). The AFTT Essential Fish Habitat Assessment states that the impact to sedentary invertebrate beds (e.g., amphipod tubes, bryozoans) may be minimal and long-term.

3.8.3.4 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. Included are potential impacts from two types of military expended materials: (1) fiber optic cables and guidance wires, and (2) parachutes. Aspects of entanglement stressors that are applicable to marine organisms in general are presented in Section 3.0.5.7.4 (Conceptual Framework for Assessing Effects from Entanglement).

Most marine invertebrates are less susceptible to entanglement than fishes, sea turtles, and marine mammals due to their size, behavior, and morphology. Fishing nets, which are designed to take marine invertebrates, operate by enclosing rather than entangling. Marine invertebrates seem to be somewhat less susceptible than vertebrates to entanglement (Chuenpagdee et al. 2003; Morgan and Chuenpagdee 2003). A survey of marine debris entanglements found that marine invertebrates composed 16 percent of all animal entanglements (Ocean Conservancy 2010). The same survey cites potential entanglement in military items only in the context of waste-handling aboard ships, and not for military expended materials. Nevertheless, it is conceivable that marine invertebrates, particularly arthropods and echinoderms with rigid appendages, might become entangled in cables and guidance wires, and in parachutes. Entanglement of sessile invertebrates is discussed under physical disturbance in Section 3.8.3.3 (Physical Disturbance and Strike Stressors).

Important physical and biological characteristics of ESA-listed elkhorn and staghorn coral critical habitat are defined in Sections 3.8.2.3.2 and 3.8.2.4.2 (Habitat and Geographic Range). There is no established mechanism for entanglement stressors to affect important characteristics of this critical habitat; however, potential consequences of physical disturbance and strike stressors associated with these objects are addressed in Section 3.8.3.3.2 (Impacts from Military Expended Materials). Therefore, it is not probable that entanglement stressors could degrade the quality of elkhorn and staghorn coral critical habitat and this discussion will not be carried forward.

3.8.3.4.1 Impacts from Fiber Optic Cables and Guidance Wires

Fiber optic cables are only expended during airborne mine neutralization testing activities and torpedo guidance wires are used in training and testing activities. For a discussion of the types of activities that use guidance wires and fiber optic cables, physical characteristics of these expended materials, where they are used, and how many activities would occur under each alternative, see Sections 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires). Abrasion and shading-related impacts on sessile benthic (attached to the seafloor) marine invertebrates that may result from entanglement stressors are discussed with physical impacts in Section 3.8.3.3 (Physical Disturbance and Strike Stressors).

A marine invertebrate that might become entangled could be only temporarily confused and escape unharmed, it could be held tightly enough that it could be injured during its struggle to escape, it could be preyed upon while entangled, or it could starve while entangled. The likelihood of these outcomes cannot be predicted with any certainty because interactions between invertebrate species and entanglement hazards are not well known. Potential entanglement scenarios are based on observations of how marine invertebrates are entangled in marine debris, which is far more prone to tangling than guidance wire or fiber optic cable (Environmental Sciences Group 2005; Ocean Conservancy 2010). The small number of guidance wires and fiber optic cables expended across the Study Area results in an extremely low rate of potential encounter for marine invertebrates.

Tube-launched, optically tracked, wire-guided missiles would expend wires in the nearshore or offshore waters of the Navy Cherry Point Range Complex, during training only and are discussed together with torpedo guidance wires because their potential impacts would be similar to those described here for torpedo guidance wires, which are also expended in the Navy Cherry Point Range Complex.

3.8.3.4.1.1 No Action Alternative

<u>**Training Activities**</u>

As indicated in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires), under the No Action Alternative activities that expend fiber optic cables occur in the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems – specifically within the VACAPES, Navy Cherry Point, and JAX Range Complexes. The area that would have the greatest concentration of expended cables or wires is within the VACAPES Range Complex (specifically W-50). The W-50 location includes 123 nm^2 of sea space. Under the No Action Alternative, there would be approximately six cables per nm^2 if they were expended evenly throughout the area.

As indicated in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires), under the No Action Alternative torpedoes expending guidance wires would occur in the Northeast and Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems as well as the Gulf Stream and North Atlantic Gyre Open Ocean Areas—specifically within the Northeast, VACAPES, Navy Cherry Point, and JAX Range Complexes. Guidance wires would be concentrated in the Southeast U.S. Continental Shelf Large Marine Ecosystem in the JAX Range Complex. Guidance wires could also be expended outside the range complexes anywhere in the Gulf of Mexico portion of the Study Area.

Species that do not occur within these specified areas—including all nine ESA-listed coral species, and the ESA-candidate queen conch—would not be exposed to cables and guidance wires. Species that do occur within the areas listed above would have the potential to be exposed to cables and guidance wires. Potential consequences of entanglement on corals and critical habitat are discussed as a physical impact in Section 3.8.3.3.2 (Impacts from Military Expended Materials).

No activities occur in southern Florida or the Key West Range Complex. Therefore, there is no overlap between cables and guidance wires and elkhorn and staghorn coral critical habitat under the No Action Alternative.

Only pelagic and deep water benthic invertebrates could be exposed to this substressor; therefore, there would be no overlap between activities and shallow-water corals—including all nine ESA-listed or proposed coral species. Given the low numbers used, most marine invertebrates would never be exposed to a cable or guidance wire.

The impact of cables and guidance wires on marine invertebrates is not likely to cause injury or mortality to individuals, and impacts would be inconsequential because: (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges, (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one event, (3) exposures would be localized, and (4) marine invertebrates are not particularly susceptible to entanglement stressors, most would avoid entanglement and simply be temporarily disturbed. Activities involving cables and guidance wires are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at individual or population levels.

Pursuant to the ESA, the use of fiber optic cables or guidance wires expended during training activities as described under the No Action Alternative:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral; and*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral.*

Testing Activities

As indicated in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires) under the No Action Alternative, activities that expend fiber optic cables would occur in the Northeast and Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems, as well as the Gulf Stream Open Ocean Area—specifically within the VACAPES Range Complex and Naval Surface Warfare Center, Panama City Division Testing Range. Under the No Action Alternative, there would be approximately one cable per 17 nm^2 if they were expended evenly throughout these areas.

As indicated in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires), under the No Action Alternative torpedoes expending guidance wires would occur in the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems, as well as the Gulf Stream Open Ocean Area—specifically within the Northeast, VACAPES, Navy Cherry Point, and JAX Range Complexes, the Cape Cod torpedo exercise box in the northeast, Narragansett Bay and surrounding waters, and Other AFTT Areas.

Species that do not occur within these specified areas—including all nin ESA-listed and proposed coral species—would not be exposed to cables and guidance wires. Species that do occur within the areas listed above—including the ESA-candidate queen conch—would have the potential to be exposed to cables and guidance wires. Potential consequences of entanglement on corals and critical habitat are discussed as a physical impact in Section 3.8.3.3.2 (Impacts from Military Expended Materials).

Only pelagic and deep-water benthic invertebrates could be exposed to this substressor. Therefore, there would be no overlap between activities and shallow-water corals—including any of the nine ESA-listed or proposed coral species. All locations potentially coincide with deep-water corals, and the torpedo guidance wires used in the JAX Range Complex potentially coincide with hard bottom habitat. Given the low numbers of wires used, most marine invertebrates would never be exposed to a cable or guidance wire.

The impact of cables and guidance wires on marine invertebrates is not likely to cause injury or mortality to individuals, and impacts would be inconsequential because: (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges, (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one event, (3) exposures would be localized, and (4) marine invertebrates are not particularly susceptible to entanglement stressors, most would avoid entanglement and simply be temporarily disturbed. Activities involving cables and guidance wires are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at individual or population levels.

Pursuant to the ESA, the use of fiber optic cables or guidance wires expended during testing activities as described under the No Action Alternative:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral; and*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral.*

3.8.3.4.1.2 Alternative 1

Training Activities

The activities using fiber optic cables under Alternative 1 would occur in the same geographic locations as the No Action Alternative, with the addition of activities in the GOMEX Range Complex. As indicated in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires) under Alternative 1, the number of activities that expend fiber optic cables is approximately three times that of the No Action Alternative.

As indicated in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires) under Alternative 1, more than three times as many fiber optic cables and 21 percent more guidance wires would be expended compared to the No Action Alternative. This would result in a maximum concentration of approximately one cable every 16 nm^2 if they were expended evenly throughout the area. Activities using guidance wires under Alternative 1 would occur in the same geographic locations as the No Action Alternative, with the exception of introducing guidance wires in the Other AFTT Areas while vessels are in transit.

Species that do not occur within these specified areas—including any of the nine ESA-listed coral species—would not be exposed to cables and guidance wires. Species that do occur within the areas listed above, including the ESA-candidate queen conch would have the potential to be exposed to cables and guidance wires. Potential consequences of entanglement on corals and critical habitat are discussed as a physical impact in Section 3.8.3.3.2 (Impacts from Military Expended Materials).

No activities occur in southern Florida or the Key West Range Complex. Therefore, there is no overlap between cables and guidance wires and elkhorn and staghorn coral critical habitat under Alternative 1.

Only pelagic and deep-water benthic invertebrates could be exposed to this substressor. Therefore, there would be no overlap between activities and shallow-water corals—including any of the nine ESA-listed coral species. Given the low numbers used, most marine invertebrates would never be exposed to a cable or guidance wire.

As stated in Section 3.8.3.4.1.1 (No Action Alternative), cables and guidance wires are not likely to cause injury or mortality to individuals—including ESA-listed species. The use of cables and guidance wires would not reduce the conservation value of critical habitat for elkhorn and staghorn coral because overlap between the stressor and resource is not anticipated. In comparison to the No Action Alternative, the increase in activities does not substantially increase the risk of exposure to cables and guidance wires.

Pursuant to the ESA, the use of fiber optic cables or guidance wires expended during training activities as described under Alternative 1:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral; and*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral.*

Testing Activities

As indicated in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires), under Alternative 1, the number of activities that expend fiber optic cables is more than two times that of the No Action Alternative. Activities using fiber optic cables under Alternative 1 would occur in the same geographic locations as the No Action Alternative, except that activities may occur in the JAX Range Complex and throughout the Gulf of Mexico. This would result in a maximum concentration of approximately one cable per 7 nm^2 if they were expended evenly throughout the area.

As indicated in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires) under Alternative 1, the number of activities that expend guidance wires is approximately six times that of the No Action Alternative. The torpedo activities using guidance wires under Alternative 1 would occur in the same geographic locations as the No Action Alternative, with the exception of eliminating guidance wires from the Cherry Point Range Complex and introducing guidance wires anywhere in the Gulf of Mexico portion of the Study Area.

Species that do not occur within these specified areas—including any of the nine ESA-listed coral species—would not be exposed to cables and guidance wires. Species that do occur within the areas listed above, including the ESA-candidate queen conch would have the potential to be exposed to cables and guidance wires. Potential consequences of entanglement on corals and critical habitat are discussed as a physical impact in Section 3.8.3.3.2 (Impacts from Military Expended Materials).

Only pelagic and deep-water benthic invertebrates could be exposed to this substressor. Therefore, there would be no overlap between activities and shallow-water corals—including any of the nine ESA-listed coral species. Under Alternative 1, all locations of fiber optic cable use in the Study Area potentially coincide with deep-water corals, and torpedo guidance wires used in the JAX Range Complex potentially coincide with hard bottom habitat. Given the numbers used, most marine invertebrates would never be exposed to a cable or guidance wire.

As stated in Section 3.8.3.4.1.1 (No Action Alternative), cables and guidance wires are not likely to cause injury or mortality to individuals—including ESA-listed species. The use of cables and guidance wires would not reduce the conservation value of critical habitat for elkhorn and staghorn coral because overlap between the stressor and resource is not anticipated. In comparison to the No Action Alternative, the increase in activities does not substantially increase the risk of exposure to cables and guidance wires.

Pursuant to the ESA, the use of fiber optic cables or guidance wires expended during testing activities as described under Alternative 1:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral; and*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral.*

3.8.3.4.1.3 Alternative 2 (Preferred Alternative)

Training Activities

The number and location of training activities under Alternative 2 are identical to training activities under Alternative 1. Therefore, impacts and comparisons to the No Action Alternative will also be identical as described in Section 3.8.3.4.1.2 (Alternative 1).

Testing Activities

As indicated in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires) under Alternative 2, the number of activities that expend fiber optic cables is 2.5 times higher than that of the No Action Alternative, but only increases by approximately 17 percent as compared to Alternative 1. The activities using fiber optic cables under Alternative 2 would occur in the same geographic locations as the No Action Alternative, except that activities may occur in the JAX Range Complex and throughout the Gulf of Mexico. This would result in a maximum concentration of approximately one cable per 7 nm^2 if they were expended randomly in this area.

As indicated in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires), under Alternative 2, the number of activities that expend guidance wires is approximately six times that of the No Action Alternative, but only increases by approximately 13 percent as compared to Alternative 1. The torpedo activities using guidance wires under Alternative 2 would occur in the same geographic locations as the No Action Alternative, with the exception of introducing guidance wires anywhere in the Gulf of Mexico portion of the Study Area.

Species that do not occur within these specified areas—including any of the nine ESA-listed coral species—would not be exposed to cables and guidance wires. Species that do occur within the areas listed above, including the ESA-candidate queen conch would have the potential to be exposed to cables and guidance wires. Potential consequences of entanglement on corals and critical habitat are discussed as a physical impact in Section 3.8.3.3.2 (Impacts from Military Expended Materials).

Only pelagic and deep-water benthic invertebrates could be exposed to this substressor. Therefore, there would be no impact on shallow-water corals—including any of the nine ESA-listed coral species. Under Alternative 2, all locations of fiber optic cable use in the Study Area potentially coincide with deep-water corals, and torpedo guidance wires used in the JAX Range Complex potentially coincide with hard bottom habitat. Given the numbers used, most marine invertebrates would never be exposed to a cable or guidance wire.

As stated in Section 3.8.3.4.1.1 (No Action Alternative), cables and guidance wires not likely to cause injury or mortality to individuals—including ESA-listed species. The use of cables and guidance wires would not reduce the conservation value of critical habitat for elkhorn and staghorn coral because overlap between the stressor and resource is not anticipated. In comparison to the No Action Alternative, the increase in activities does not substantially increase the risk of exposure to cables and guidance wires.

Pursuant to the ESA, the use of fiber optic cables or guidance wires expended during testing activities as described under Alternative 2:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral;*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral.*

3.8.3.4.2 Impacts from Parachutes

Parachutes of varying sizes are used during training and testing activities. For a discussion of the types of activities that use parachutes, physical characteristics of these expended materials, where they are used, and how many activities would occur under each alternative, see Section 3.0.5.3.4.2 (Parachutes). Parachutes pose a potential, though unlikely, entanglement risk to susceptible marine invertebrates. The most likely method of entanglement would be a marine invertebrate crawling through the fabric or cord that could then tighten around it.

Abrasion and shading-related impacts on sessile benthic marine invertebrates that may result from entanglement stressors are discussed with physical impacts in Section 3.8.3.3 (Physical Disturbance and Strike Stressors). Potential indirect effects of the parachute being transported laterally along the seafloor are discussed in Section 3.8.3.6 (Secondary Stressors).

Shallow- or deep-water coral species potentially occur everywhere that parachute use occurs. The ESA-listed and proposed coral species are susceptible to entanglement in parachutes, but the principal mechanism of damage is shading and abrasion. Therefore, this potential stressor is addressed in Section 3.8.3.3.2 (Impacts from Military Expended Materials). Entanglement of corals that results in breakage was addressed in the same section. Similarly entanglement cannot affect habitat and the discussion of potential consequences to critical habitat will not be carried forward. However, potential consequences of physical disturbance and strike stressors associated with these objects are addressed in Section 3.8.3.3.2 (Impacts from Military Expended Materials).

A marine invertebrate that might become entangled could be temporarily confused and escape unharmed, held tightly enough that it could be injured during its struggle to escape, preyed upon while entangled, or starved while entangled. The likelihood of these outcomes cannot be predicted with any certainty because interactions between invertebrate species and entanglement hazards are not well known. Potential entanglement scenarios are based on observations of how marine invertebrates are entangled in marine debris (Environmental Sciences Group 2005; Ocean Conservancy 2010). The number of parachutes expended across the Study Area is extremely small relative to the number of marine invertebrates, resulting in a low rate of potential encounter for marine invertebrates.

3.8.3.4.2.1 No Action Alternative

Training Activities

The number and footprint of parachutes are detailed in Table 3.3-9. As indicated in Section 3.0.5.3.4.2 (Parachutes) under the No Action Alternative, activities involving parachute use would occur in the Northeast and Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems as well as the Gulf Stream and North Atlantic Gyre Open Ocean Areas—specifically within the Northeast, VACAPES, Navy Cherry Point, and JAX Range Complexes; and anywhere in the Gulf of Mexico portion of the Study Area, as well as Other AFTT Areas while vessels are in transit. To estimate a worst-case scenario, calculations were made for the area where parachutes would be expended with greatest concentration. For training events, this is in the Southeast U.S. Continental Shelf Large Marine Ecosystem and Gulf Stream Open Ocean Area (specifically, the JAX Range Complex). Under the No Action Alternative, there would be a concentration of approximately one parachute per 2 nm^2 if they were evenly expended throughout the area.

Species that do not occur within these specified areas—including any of the nine ESA-listed coral species—would not be exposed to parachutes. Species that do occur within the areas listed above, including the ESA-candidate queen conch would have the potential to be exposed to parachutes. Potential consequences of entanglement on corals and critical habitat are discussed as a physical impact in Section 3.8.3.3.2 (Impacts from Military Expended Materials).

No activities occur in southern Florida or the Key West Range Complex. Therefore, there is no overlap between parachutes and elkhorn and staghorn coral critical habitat under the No Action Alternative.

Most marine invertebrates would never encounter a parachute. The impact of parachutes on marine invertebrates is not likely to cause injury or mortality to individuals, and impacts would be inconsequential because: (1) the area exposed to the stressor is extremely small relative to most marine invertebrates' ranges, (2) the activities are dispersed such that few individuals could conceivably be exposed to more than one event, (3) exposures would be localized, and (4) marine invertebrates are not particularly susceptible to entanglement stressors, most would avoid entanglement and simply be temporarily disturbed. Activities involving parachutes are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of invertebrate species at individual or population levels.

Pursuant to the ESA, the use of parachutes expended during training activities as described under the No Action Alternative:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral; and*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral.*

Testing Activities

The number and footprint of parachutes are detailed in Table 3.3-10. As indicated in Section 3.0.5.3.4.2 (Parachutes), under the No Action Alternative, activities involving parachute use would occur in the Northeast and Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems, as well as the Gulf Stream and North Atlantic Gyre Open Ocean Areas—specifically within the Northeast, VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes and in Other AFTT Areas while vessels are in transit. To estimate a worst-case scenario, calculations were made for the area where parachutes would be expended with greatest concentration. For testing events, this is in Northeast U.S. Continental Shelf Large Marine Ecosystem and the Gulf Stream Open Ocean Area (specifically, in the VACAPES Range Complex). Under the No Action Alternative, there would be a concentration of approximately one parachute per 22 nm^2 if the parachutes were expended evenly throughout the area.

Species that do not occur within these specified areas would not be exposed to parachutes. Species that do occur within the areas listed above—including the ESA-candidate queen conch—would have the potential to be exposed to parachutes. Activities could overlap with ESA-listed or proposed coral and elkhorn and staghorn coral critical habitat in Other AFTT Areas. However, overlap is unlikely because mitigation measures, discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) minimize potential exposures to these military expended materials. Potential consequences of entanglement on corals and critical habitat are discussed as a physical impact in Section 3.8.3.3.2 (Impacts from Military Expended Materials).

Most marine invertebrates would never encounter a parachute. Some individual marine invertebrates could be injured or killed in the unlikely event of exposure and entanglement, but most mobile marine invertebrates would avoid entanglement and simply be temporarily disturbed and would recover completely soon after exposure. The growth, survival, annual reproductive success, or lifetime reproductive success of populations would not be impacted directly or indirectly.

Pursuant to the ESA, entanglement in parachutes expended during testing activities as described under the No Action Alternative:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral; and*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral.*

3.8.3.4.2.2 Alternative 1

Training Activities

The number and footprint of parachutes are detailed in Table 3.3-11. As indicated in Section 3.0.5.3.4.2 (Parachutes), under Alternative 1, the number of activities involving the use of parachutes is approximately 5 percent higher than that of the No Action Alternative. In addition to the geographic locations identified in the No Action Alternative, parachutes would also be expended in the Key West and GOMEX Range Complexes. Under Alternative 1, there would be a concentration of approximately one parachute per 2 nm^2 if the parachutes were expended evenly throughout the area.

Species that do not occur within these specified areas would not be exposed to parachutes. Species that do occur within the areas listed above—including the ESA-candidate queen conch—would have the potential to be exposed to parachutes. Activities could overlap with ESA-listed or proposed coral and elkhorn and staghorn coral critical habitat in Other AFTT Areas. However, overlap is unlikely because mitigation measures, discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and

Monitoring) minimize potential exposures to these military expended materials. Potential consequences of entanglement on corals and critical habitat are discussed as a physical impact in Section 3.8.3.3.2 (Impacts from Military Expended Materials).

Most marine invertebrates would never encounter a parachute. As stated in Section 3.8.3.4.2.1 (No Action Alternative), parachute entanglement is not likely to cause injury or mortality to individuals—including ESA-listed species. The use of parachutes would not reduce the conservation value of critical habitat for elkhorn and staghorn coral because overlap between the stressor and resource is not anticipated. In comparison to the No Action Alternative, the increase in activities does not substantially increase the risk of exposure to parachutes.

Pursuant to the ESA, the use of parachutes expended during training activities as described under Alternative 1:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral; and*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral.*

Testing Activities

The number and footprint of parachutes are detailed in Table 3.3-12. As indicated in Section 3.0.5.3.4.2 (Parachutes), under Alternative 1 the number of activities involving the use of parachutes is four times that of the No Action Alternative. The activities using parachutes under Alternative 1 would occur in the same geographic locations as the No Action Alternative, with the exception of introducing parachutes in the Key West Range Complex, Gulf of Mexico, and throughout the Study Area. To estimate a worst-case scenario, calculations were made for the area where parachutes would be expended with greatest concentration. For testing events, this is in Northeast U.S. Continental Shelf Large Marine Ecosystem and the Gulf Stream Open Ocean Area (specifically, in the VACAPES Range Complex). Under Alternative 1, there would be a concentration of approximately one parachute per 5 nm^2 if the parachutes were expended evenly throughout the area.

Species that do not occur within these specified areas would not be exposed to parachutes. Species that do occur within the areas listed above—including the ESA-candidate queen conch—would have the potential to be exposed to parachutes. Activities that occur anywhere in the AFTT Study Area will overlap with ESA-listed or proposed coral and elkhorn and staghorn coral critical habitat only if the activities occur shallow waters in or near the Key West Range Complex or the South Florida Ocean Measurement Facility Testing Range. However, overlap is unlikely because mitigation measures, discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) minimize potential exposures to these military expended materials. Potential consequences of entanglement on corals and critical habitat are discussed as a physical impact in Section 3.8.3.3.2 (Impacts from Military Expended Materials).

Most marine invertebrates would never be exposed to a parachute. As stated in Section 3.8.3.4.2.1 (No Action Alternative), parachute entanglement is not likely to cause injury or mortality to individuals—including ESA-listed species. The use of parachutes would not reduce the conservation value of critical habitat for elkhorn and staghorn coral because overlap between the stressor and resource is not anticipated. In comparison to the No Action Alternative, the increase in activities does not substantially increase the risk of exposure to parachutes.

Pursuant to the ESA, entanglement in parachutes expended during testing activities as described under Alternative 1:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral; and*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral.*

3.8.3.4.2.3 Alternative 2 (Preferred Alternative)

Training Activities

The number and location of training activities under Alternative 2 are nearly identical to training activities under Alternative 1 (3 additional parachutes relative to Alternative 1). Therefore, impacts and comparisons to the No Action Alternative will also be identical as described in Section 3.8.3.4.2.2 (Alternative 1).

Testing Activities

The number and footprint of parachutes are detailed in Table 3.3-13. As indicated in Section 3.0.5.3.4.2 (Parachutes), under Alternative 2 the number of activities involving the use of parachutes is more than five times that of the No Action Alternative, but only increases by approximately 19 percent as compared to Alternative 1. The activities using parachutes under Alternative 2 would occur in the same geographic locations as the No Action Alternative, with the exception of introducing parachutes in the Gulf of Mexico Large Marine Ecosystem in the Key West Range Complex and Gulf of Mexico, and throughout the AFTT Study Area. Under Alternative 2, there would be a concentration of approximately one parachute per 4 nm^2 if the parachutes were expended evenly throughout the area.

Species that do not occur within these specified areas would not be exposed to parachutes. Species that do occur within the areas listed above—including the ESA-candidate queen conch—would have the potential to be exposed to parachutes. Activities that occur anywhere in the AFTT Study Area will overlap with ESA-listed or proposed coral and elkhorn and staghorn coral critical habitat if the activities occur in shallow waters within or near the Key West Range Complex or the South Florida Ocean Measurement Facility Testing Range. However, overlap is unlikely because mitigation measures, discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring), minimize potential exposures to these military expended materials. Potential consequences of entanglement on corals and critical habitat are discussed as a physical impact in Section 3.8.3.3.2 (Impacts from Military Expended Materials).

Most marine invertebrates would never be exposed to a parachute. As stated in Section 3.8.3.4.2.1 (No Action Alternative), parachute entanglement is not likely to cause injury or mortality to individuals—including ESA-listed species. The use of parachutes would not reduce the conservation value of critical habitat for elkhorn and staghorn coral because overlap between the stressor and resource is not anticipated. In comparison to the No Action Alternative, the increase in activities does not substantially increase the risk of exposure to parachutes.

Pursuant to the ESA, the use of parachutes expended during testing activities as described under Alternative 2:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral; and*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral.*

3.8.3.5 Ingestion Stressors

This section analyzes the potential ingestion impacts of the various types of expended materials used by the Navy during training and testing activities within the Study Area. Aspects of ingestion stressors that are applicable to marine organisms in general are presented in Section 3.0.5.7.5 (Conceptual Framework for Assessing Effects from Ingestion).

Ingestion of expended materials by marine invertebrates 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 animal. Floating material is more likely to be eaten by animals that feed at or near the water surface, while materials that sink to the seafloor present a higher risk to bottom-feeding animals. While marine invertebrates are universally present in the water and the seafloor, the majority of individuals are smaller than a few millimeters (e.g., zooplankton, most roundworms, and most arthropods). Most military expended materials and fragments of military expended materials are too large to be ingested by marine invertebrates. The potential for marine invertebrates to encounter fragments of ingestible size increases as the military expended materials degrade into smaller fragments.

Among invertebrates, many arthropods such as blue crab (*Callinectes sapidus*) and spiny lobster (*Panulirus argus*) are known to discriminate between palatable and unpalatable food items inside the mouth, so in a strict sense, only items that are passed into the interior digestive tract should be considered to be ingested (Aggio et al. 2012). If an expended material is ingested by marine invertebrates, the primary risk is associated with blockages in the digestive tract. Most components used in military expended materials are relatively inert in the marine environment and are not likely to cause injury or mortality via chemical effects. Section 3.8.3.6 (Secondary Stressors) provides more information on the chemical properties of these materials.

3.8.3.5.1 Impacts from Military Expended Materials

Impacts from Military Expended Materials in this section include munitions, fragments from high-explosive munitions, and military expended materials other than munitions. The most abundant military expended material of ingestible size is chaff. The materials in chaff are generally nontoxic in the marine environment except in quantities substantially larger than those any marine invertebrate could reasonably be exposed to from normal use. Fibers are composed of an aluminum alloy coating on glass fibers of silicon dioxide (Section 3.0.5.3.5.3, Military Expended Materials Other Than Munitions). Chaff is similar in form to fine human hair and somewhat analogous to the spicules of sponges or the siliceous cases of diatoms (Spargo 1999). Many invertebrates ingest sponges, including the spicules, without suffering harm (Spargo 1999). Marine invertebrates may occasionally encounter chaff fibers in the marine environment and may incidentally ingest chaff when they take in prey or water. Literature reviews and controlled experiments detailed in Section 3.0.5.3.5.3 (Military Expended Materials Other Than Munitions), suggest that chaff poses little environmental risk to marine organisms at concentrations that could reasonably occur from military training and testing (Arfsten et al. 2002; Spargo 1999). Studies were conducted to determine likely effects to marine invertebrates from ingestion of chaff involving a laboratory investigation of crabs that were fed radiofrequency chaff. Blue crabs were force fed a chaff-and-food mixture daily for a few weeks at concentrations 10 to 100 times predicted real-world exposure levels without a notable increase in mortality (Arfsten et al. 2002). Some aluminum compounds bioaccumulate in the marine food chain and are weakly toxic (U.S. Department of the Navy 2012).

As described in Section 3.8.2 (Affected Environment), tens of thousands of marine invertebrate species occur in the Study Area. There is little literature regarding the effects of debris ingestion on marine invertebrates; consequently, there is little basis for an evidence-based assessment of risks. It is not feasible to speculate on which invertebrates in which locations might ingest specific types of military expended materials. However, invertebrates that actively forage (e.g., worms, octopus, shrimp, and sea cucumbers) are at much greater risk of military expended materials ingestion than invertebrates that filter-feed (e.g., sponges, corals, oysters, and barnacles). Though ingestion is possible in some circumstances, based on the little scientific information available, it seems that negative impacts on individuals are unlikely and the potential for impacts on populations would be inconsequential and not detectable. Adverse consequences of marine invertebrates ingesting military expended materials are possible, but not probable.

Important physical and biological characteristics of ESA-listed elkhorn and staghorn coral critical habitat are defined in Sections 3.8.2.3.2 and 3.8.2.4.2 (Habitat and Geographic Range). There is no established mechanism for ingestion stressors to affect important characteristics of this critical habitat and the discussion of potential consequences to critical habitat will not be carried forward. Potential impacts of military expended material on corals and critical habitat are discussed and analyzed as a physical impact in Section 3.8.3.3.2 (Impacts from Military Expended Materials).

3.8.3.5.1.1 No Action Alternative

<u>Training Activities</u>

Under the No Action Alternative, a variety of potentially ingestible military expended materials would be released to the marine environment by Navy training activities, as described in Section 3.0.5.3.5 (Ingestion Stressors). The number and locations of activities that expend potentially ingestible materials are detailed in Section 3.0.5.3.5 (Ingestion Stressors) and the numbers of expended materials are detailed in Table 3.3-9. The amount of ingestible military expended material that an individual animal would encounter is generally low based on the patchy distribution of expended materials.

Ingestion is not likely in the majority of cases because most military expended materials are too large to be ingested by most marine invertebrates. Military expended materials of ingestible size, or that become ingestible after degradation, are unlikely to impact individuals. Though ingestion is possible in some circumstances, based on the little scientific information available, it seems that negative impacts on individuals—including the ESA-candidate queen conch—are unlikely and the potential for impacts on populations would be inconsequential and not detectable. Adverse consequences of marine invertebrates ingesting military expended materials are possible, but not probable.

Pursuant to the ESA, the potential for ingestion of military expended materials expended during training activities as described under the No Action Alternative:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral; and*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral.*

<u>Testing Activities</u>

Under the No Action Alternative, a variety of potentially ingestible military expended materials would be released into the marine environment by Navy testing activities, as described in Section 3.0.5.3.5 (Ingestion Stressors). The number and locations of activities that expend potentially ingestible materials are detailed in Section 3.0.5.3.5 (Ingestion Stressors) and the numbers of expended materials are detailed in Table 3.3-10.

Ingestion is not likely in the majority of cases because most military expended materials are too large to be ingested by most marine invertebrates. Military expended materials of ingestible size, or that become ingestible after degradation, are unlikely to impact individuals. Though ingestion is possible in some circumstances, based on the little scientific information available, it seems that negative impacts on individuals—including the ESA-candidate queen conch—are unlikely and the potential for impacts on populations would be inconsequential and not detectable. Adverse consequences of marine invertebrates ingesting military expended materials are possible, but not probable.

Pursuant to the ESA, the potential for ingestion of military expended materials expended during testing activities as described under the No Action Alternative:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral; and*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral.*

3.8.3.5.1.2 Alternative 1

Training Activities

Under Alternative 1, a variety of potentially ingestible military expended materials would be released into the marine environment by Navy training activities, as described in Section 3.0.5.3.5 (Ingestion Stressors). The number and locations of activities that expend potentially ingestible materials are detailed in Section 3.0.5.3.5 (Ingestion Stressors) and the numbers of expended materials are detailed in Table 3.3-11.

As stated in Section 3.8.3.5.1.1 (No Action Alternative), ingestion stressors are not likely to cause injury or mortality to individuals—including ESA-listed, ESA-proposed, or ESA-candidate species. In comparison to the No Action Alternative, the increase in activities does not substantially increase the risk of exposure to ingestion stressors.

Pursuant to the ESA, the potential for ingestion of military expended materials expended during training activities as described under Alternative 1:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral; and*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral.*

Testing Activities

Under Alternative 1, a variety of potentially ingestible military expended materials would be released into the marine environment by Navy testing activities, as described in Section 3.0.5.3.5 (Ingestion Stressors). The number and locations of activities that expend potentially ingestible materials are detailed in Section 3.0.5.3.5 (Ingestion Stressors) and the numbers of expended materials are detailed in Table 3.3-12.

As stated in Section 3.8.3.5.1.1 (No Action Alternative), ingestion stressors are not likely to cause injury or mortality to individuals—including ESA-listed, ESA-proposed, or ESA-candidate species. In comparison to the No Action Alternative, the increase in activities does not substantially increase the risk of exposure to ingestion stressors.

Pursuant to the ESA, the potential for ingestion of military expended materials expended during testing activities as described under Alternative 1:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral; and*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral.*

3.8.3.5.1.3 Alternative 2 (Preferred Alternative)

Training Activities

The number and location of training activities under Alternative 2 are identical to training activities under Alternative 1. Therefore, impacts and comparisons to the No Action Alternative will also be identical as described in Section 3.8.3.5.1.2 (Alternative 1).

Testing Activities

Under Alternative 2, a variety of potentially ingestible military expended materials would be released into the marine environment by Navy testing activities, as described in Section 3.0.5.3.5 (Ingestion Stressors). The number and locations of activities that expend potentially ingestible materials are detailed in Section 3.0.5.3.5 (Ingestion Stressors) and the numbers of expended materials are detailed in Table 3.3-13.

As stated in Section 3.8.3.5.1.1 (No Action Alternative), ingestion stressors are not likely to cause injury or mortality to individuals—including ESA-listed, ESA-proposed, or ESA-candidate species. In comparison to the No Action Alternative, the increase in activities does not substantially increase the risk of exposure to ingestion stressors.

Pursuant to the ESA, the potential for ingestion of military expended materials expended during testing activities as described under Alternative 2:

- *will have no effect on ESA-listed elkhorn coral or staghorn coral; and*
- *will have no effect on ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral.*

3.8.3.6 Secondary Stressors

This section analyzes potential impacts on marine invertebrates exposed to stressors indirectly through impacts on their habitat (i.e., sediment and water quality, and physical disturbance). These two ecosystem constituents—sediment and water quality—are also primary constituents of marine invertebrate habitat, and firm distinctions between indirect impacts and habitat impacts are difficult to maintain. For this analysis, indirect impacts on marine invertebrates via sediment or water that do not require trophic transfer (e.g., bioaccumulation, predation) to be observed are considered here. Potential impacts that can only be observed after trophic transfer are considered in the *Ecosystem Technical Report for the Atlantic Fleet Training and Testing (AFTT) Draft Environmental Impact Statement* (U.S. Department of the Navy 2012). 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 marine invertebrates via impacts to habitat. These include: (1) explosives and byproducts, (2) metals, (3) chemicals, (4) other materials such as targets, chaff, and plastics, and (5) physical disturbance.

The Navy does not intentionally take marine invertebrates, and avoiding contact with the seafloor as part of human safety precautions also minimizes potential impacts on shallow benthic marine invertebrates such as corals and oysters. See Chapter 4 (Cumulative Impacts) and U.S. Department of the Navy (2012) for more detailed discussions of Navy activities in the context of other industries.

Secondary or indirect stressors may impact benthic invertebrates, eggs, and larvae by sediment and water quality, and physical disturbance of individuals. Important physical and biological characteristics of ESA-listed elkhorn and staghorn coral critical habitat are defined in Sections 3.8.2.3.2 and 3.8.2.4.2 (Habitat and Geographic Range). These characteristics can be summarized as any hard substrate of suitable quality and availability to support settlement, recruitment, and attachment at depths from mean low water to 30 m within the organism's former geographic range (FR 73(229): 72210-72241, November 26, 2008). Primary constituent elements were not formally defined for these species. Exemptions from critical habitat designations include a small zone around Naval Air Station Key West, and a small area within the South Florida Ocean Measurement Facility Testing Range (Sections 3.8.2.3.1 and 3.8.2.4.1, Status and Management). All activities, including secondary stressors in the Key West Range Complex and the South Florida Ocean Measurement Facility Testing Range, could expose this substrate to disturbances that could degrade the quality of critical habitat.

3.8.3.6.1 Explosives, Explosion Byproducts, and Unexploded Ordnance

High-order explosions consume most of the explosive material, creating typical combustion products. In the case of royal demolition explosive, 98 percent of the products are common seawater constituents and the remainder is rapidly diluted below threshold effect level (see Section 3.1.3.1.2, Background, and Table 3.1-8). Explosion byproducts associated with high-order detonations present no indirect stressors to marine invertebrates through sediment or water. Low-order detonations and unexploded ordnance present elevated likelihood of effects on marine invertebrates, and the potential impacts of these on marine invertebrates will be analyzed. 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 (Table 3.1-10). Undetonated explosives associated with ordnance disposal and mine clearance are collected after training is complete; therefore, potential impacts are assumed to be inconsequential and not detectable for these training and testing activities. Marine invertebrates may be exposed by contact with the explosive, contact with contaminants in the sediment or water, and ingestion of contaminated sediments. Most marine invertebrates are very small relative to ordnance or fragments, and direct ingestion of unexploded ordnance is unlikely.

Indirect impacts of explosives and unexploded ordnance on marine invertebrates via sediment is possible in the immediate vicinity of the ordnance. Degradation of explosives proceeds via several pathways discussed in Section 3.1.3.1 (Explosives and Explosion Byproducts). Degradation products of royal demolition explosive are not toxic to marine organisms including corals, and have reversible neurological effects for other invertebrates at realistic exposure levels (Garcia-Reyero et al. 2011; Rosen and Lotufo 2010). Trinitrotoluene (TNT) and its degradation products impact developmental processes in marine invertebrates and are acutely toxic to adults at concentrations similar to real-world exposures (Rosen and Lotufo 2007b, 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 6–12 in. (15–30 cm) away from degrading ordnance, the concentrations of these compounds were not statistically distinguishable from background beyond 3 and 6 ft. (1 and 2 m) from the degrading ordnance (Section 3.1.3.1, Explosives and Explosion Byproducts). Taken together, it is likely that marine invertebrates, eggs, and larvae would be adversely impacted by the indirect effects of degrading explosives within a very small radius of the explosive (1–6 ft. [0.3–2 m]).

Indirect impacts of explosives and unexploded ordnance on marine invertebrates via water are likely to be inconsequential and not detectable for two reasons. First, most explosives and explosive degradation products have very low solubility in seawater (Table 3.1-13). This means that dissolution occurs extremely slowly, and harmful concentrations of explosives and degradation are unlikely to accumulate except within confined spaces. Second, a low concentration of contaminants, slowly delivered into the water column, is readily diluted to harmless concentrations. While it is conceivable that marine invertebrates may be adversely impacted by the indirect effects of degrading explosives via water (Rosen and Lotufo 2007a, 2010), this is extremely unlikely in realistic scenarios.

Impacts on marine invertebrates, zooplankton, eggs, and larvae are likely within a very small radius of the ordnance (1–6 ft. [0.3–2 m]). These impacts may continue as the ordnance degrades over months to decades (Section 3.1.3.1.5, Impacts from Explosives and Explosion Byproducts). Because most ordnance is deployed as projectiles, it is unlikely that multiple unexploded or low-order detonations will accumulate on spatial scales of 1–6 ft. (0.3–2 m); therefore, potential impacts are likely to remain localized and widely separated. Given these conditions, the possibility of population-level impacts on marine invertebrates is inconsequential.

3.8.3.6.2 Metals

Certain metals and metal-containing compounds are harmful to marine invertebrates at concentrations above background levels (e.g., cadmium, chromium, lead, mercury, zinc, copper, manganese, and many others) (Chan et al. 2012; Negri et al. 2002; Wang and Rainbow 2008). Responses vary from physiological toxicity to subtle behavioral changes that affect escape from predators (Gutierrez et al. 2012). Metals are introduced into seawater and sediments as a result of training and testing activities involving vessel hulks, targets, ordnance, munitions, and other military expended material including batteries (extensively discussed in Section 3.1.3.2, Metals). Many metals bioaccumulate and some physiological impacts begin to occur only after several trophic transfers concentrate the toxic metals (U.S. Department of the Navy 2012). Different species, even sister species, have highly varied tolerances for metals and diverse mechanisms to cope with these physiological stressors (Figueira et al. 2012; Gall et al. 2012). Indirect impacts of metals to marine invertebrates via sediment and water involve concentrations several orders of magnitude lower than concentrations achieved via bioaccumulation. Marine invertebrates may be exposed by contact with the metal, contact with contaminants in the sediment or water, and ingestion of contaminated sediments. Ingested metal contaminants are toxic at substantially lower effective concentrations than contaminants dissolved or suspended in the water (Brix et al. 2012). Most marine invertebrates are very small relative to Navy military expended materials or fragments of military expended materials, and direct ingestion of metals is unlikely.

Because metals often concentrate in sediments, potential adverse indirect impacts are much more likely via sediment than via water (Zhao et al. 2012). Despite the acute toxicity of some metals (e.g., hexavalent chromium or tributyltin) (Negri et al. 2002) concentrations above safe limits are scarcely encountered even in live fire areas of Vieques, Puerto Rico, where deposition of metals from Navy activities is very high (Section 3.1.3.2, Metals). Other studies described in Section 3.1.3.2 (Metals) find no harmful concentrations of metals associated with deposition of military metals into the marine environment. It is conceivable that marine invertebrates, eggs, or larvae could be indirectly impacted by metals via sediment within a few inches of the object.

Concentrations of metals in seawater are orders of magnitude lower than concentrations in marine sediments. It is extremely unlikely that marine invertebrates would be indirectly impacted by Navy-derived toxic metals via the water, in the absence of bioaccumulation. It is conceivable, though extremely unlikely, that marine invertebrates, eggs, or larvae could be indirectly impacted by metals via sediment within a few inches of the object, but these potential impacts would be localized and widely separated. Concentrations of metals in water are extremely unlikely to be high enough to cause injury or mortality to marine invertebrates; therefore, indirect impacts of metals via water are likely to be inconsequential and not detectable. Given these conditions, the possibility of population-level impacts on marine invertebrates is likely to be inconsequential and not detectable.

3.8.3.6.3 Chemicals

Several Navy training and testing activities introduce potentially harmful chemicals into the marine environment, principally, flares, and propellants for rockets, missiles, and torpedoes. Polychlorinated biphenyls (PCBs) are discussed in Section 3.1.3.3 (Chemicals Other Than Explosives), but there is inconsequential additional risk to marine invertebrates because the use of PCBs in U.S. applications, including the Navy, has been nearly nonexistent since 1979. Properly functioning flares, missiles, rockets, and torpedoes combust most of their propellants, leaving benign or readily diluted soluble combustion byproducts (e.g., hydrogen cyanide). Operational failures allow release of propellants and their degradation products into the marine environment. The greatest risk to marine invertebrates from flares, missiles, and rocket propellants is perchlorate, which is highly soluble in water, persistent, and impacts metabolic processes in many plants and animals. Torpedo propellant poses little risk to marine invertebrates because the chemicals have relatively low toxicity (Section 3.1.3.3.2, Missile and Rocket Propellant – Solid Fuel). Marine invertebrates may be exposed by contact with the chemical, contact with chemical contaminants in the sediment or water, and ingestion of contaminated sediments. These situations typically include rapid dilution, and doses large enough to have detectable effects are uncommon in most circumstances. Most marine invertebrates are very small relative to Navy military expended materials or fragments of military expended materials, and direct ingestion of chemicals is unlikely.

The principal toxic component of missiles and rockets is perchlorate, which is highly soluble and does not readily adsorb to sediments. Therefore, missile and rocket fuel poses inconsequential risk of indirect impact on marine invertebrates via sediment and surrounding waters. In contrast, the principal toxic components of torpedo fuel—propylene glycol dinitrate and nitrodiphenylamine—adsorb to sediments, have relatively low toxicity, and are readily degraded by biological processes (Section 3.1.3.3, Chemicals Other Than Explosives). It is conceivable that marine invertebrates, eggs, or larvae could be indirectly impacted by propellants via sediment in the immediate vicinity of the object (e.g., within a few inches), but these potential impacts would diminish rapidly as the propellant degrades.

In seawater, however, perchlorate, the principal ingredient of solid missile and rocket propellant, is highly soluble, persistent, and impacts metabolic processes in many plants and animals. Perchlorate contamination rapidly disperses throughout the water column and water within sediments. While it impacts terrestrial biological processes at low concentrations (e.g., less than 10 parts per billion), toxic concentrations are unlikely to be encountered in seawater. The principal mode of perchlorate toxicity in the environment is bioaccumulation, which is discussed separately in U.S. Department of the Navy (2012).

Torpedo propellants have relatively low toxicity and pose inconsequential risk to marine invertebrates. It is conceivable that marine invertebrates, zooplankton, eggs, or larvae could be indirectly impacted by hydrogen cyanide produced by torpedo fuel combustion, but these impacts would diminish rapidly as the chemical becomes diluted below toxic levels. Chemicals are rapidly diluted, readily biodegraded, or both, and concentrations high enough to be acutely toxic are unlikely in the marine environment (see Section 3.1.3.3, Chemicals Other Than Explosives, for a discussion of these mechanisms). Concentrations of chemicals in sediment and water are unlikely to be high enough to cause injury or mortality to marine invertebrates; therefore, indirect impacts of chemicals via sediment and water are likely to be inconsequential and not detectable. Potential impacts of chemicals after bioaccumulation are discussed separately. Given these conditions, the possibility of population-level impacts on marine invertebrates is likely to be inconsequential and not detectable.

3.8.3.6.4 Other Materials

Military expended materials that are re-mobilized after their initial contact with the seafloor (e.g., by waves or currents) may continue to strike or abrade marine invertebrates. Secondary physical strike and disturbances are relatively unlikely because most expended materials are denser than their surrounding sediments (i.e., metal) and are likely to remain in place as the surrounding sediment moves. The principal exception is likely to be parachutes, which are moved easily relative to projectiles and fragments. Potential secondary physical strike and disturbance impacts may cease only when the: (1) military expended material is too massive to be mobilized by typical oceanographic processes, (2) military expended material becomes encrusted by natural processes and incorporated into the seafloor, or (3) military expended material becomes permanently buried. The fitness of individual organisms would be impacted directly or indirectly, but not to the extent that viability of populations or species would be impacted.

All military expended material, including targets and vessel hulks involved in sinking exercises that contains materials other than metal, explosives, or chemicals, is evaluated for potential indirect impacts on marine invertebrates via sediment and water. Principal components of these military expended materials include aluminized fiberglass (chaff), carbon or Kevlar fiber (missiles), and plastics (canisters, targets, sonobuoy components, parachutes). Potential effects of these materials are discussed in Section 3.1.3.4 (Other Materials). Chaff has been extensively studied, and no indirect toxic effects are known at realistic concentrations in the marine environment (Arfsten et al. 2002). Glass, carbon, and Kevlar fibers are not known to have potential toxic effects on marine invertebrates. Plastics contain chemicals that have potential indirect effects on marine invertebrates (Derraik 2002; Mato et al. 2001; Teuten et al. 2007). Marine invertebrates may be exposed by contact with the plastic, contact with associated plastic chemical contaminants in the sediment or water, and ingestion of contaminated sediments. Most marine invertebrates are very small relative to Navy military expended materials or fragments of military expended materials, and direct ingestion of plastics is unlikely.

The only material with the potential to impact marine invertebrates via sediment is plastics. Harmful chemicals in plastics interfere with metabolic and endocrine processes in many plants and animals (Derraik 2002). Potentially harmful chemicals in plastics are not readily adsorbed to marine sediments; instead, marine invertebrates are most at risk via ingestion or bioaccumulation (Sections 3.8.3.5, Ingestion Stressors, and U.S. Department of the Navy (2012). Because plastics retain many of their chemical properties as they physically degrade into microplastic particles (Singh and Sharma 2008), the exposure risks to marine invertebrates are dispersed over time. It is conceivable that marine invertebrates could be indirectly impacted by chemicals associated with plastics but, absent bioaccumulation, these effects would be limited to direct contact with the material. Because of these conditions, the possibility of population-level impacts on marine invertebrates attributable to Navy expended materials is likely to be inconsequential and not detectable.

3.8.3.6.5 Physical Disturbance

Important physical and biological characteristics of ESA-listed elkhorn and staghorn coral critical habitat are defined in Sections 3.8.2.3.1 and 3.8.2.4.1 (Status and Management). Secondary stressors associated with military expended materials could affect important characteristics of this critical habitat. All activities involving military expended materials in the Southeast U.S. Continental Shelf, Caribbean Sea, and the Gulf Of Mexico Large Marine Ecosystems, particularly in the Key West Range Complex and the South Florida Ocean Measurement Facility Testing Range could expose this substrate to physical disturbances that could degrade the quality of critical habitat. However, the likelihood of exposure is reduced by mitigation measures, discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring). It is unlikely that secondary stressors would reduce the conservation value of elkhorn and staghorn coral critical habitat.

3.8.3.6.6 No Action Alternative, Alternative 1, and Alternative 2 (Preferred Alternative) – Training

Pursuant to the ESA, secondary stressors for training activities as described under the No Action Alternative, Alternative 1, and Alternative 2:

- *may affect but are not likely to adversely affect ESA-listed elkhorn coral or staghorn coral;*
- *may affect but are not likely to adversely affect ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral; and*
- *may affect but are not likely to adversely affect elkhorn coral or staghorn coral critical habitat.*

3.8.3.6.7 No Action Alternative, Alternative 1, and Alternative 2 (Preferred Alternative) – Testing

Pursuant to the ESA, secondary stressors for testing activities as described under the No Action Alternative, Alternative 1, and Alternative 2:

- *may affect but are not likely to adversely affect ESA-listed elkhorn coral or staghorn coral;*
- *may affect but are not likely to adversely affect ESA-proposed boulder star coral, mountainous star coral, pillar coral, rough cactus coral, star coral, elliptical star coral, or Lamarck's sheet coral; and*
- *may affect but are not likely to adversely affect elkhorn coral or staghorn coral critical habitat.*

3.8.3.6.8 Substressor Impacts on Sedentary Invertebrate Beds or Reefs as Essential Fish Habitats (Preferred Alternative)

Pursuant to the Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of metal, chemical, and other material contaminants; and secondary physical disturbances during training and testing activities will have no adverse effect on sedentary invertebrate beds or reefs that constitute Essential Fish Habitat or Habitat Areas of Particular Concern. The use of explosives, explosion byproducts, and unexploded ordnance during training and testing activities may have an adverse effect on sedentary invertebrate beds or reefs that constitute Essential Fish Habitat or Habitat Areas of Particular Concern. The AFTT Essential Fish Habitat Assessment states that substressor impacts on invertebrate beds or reefs would be minimal and short-term (U.S. Department of the Navy 2013).

3.8.4 SUMMARY OF POTENTIAL IMPACTS ON MARINE INVERTEBRATES

3.8.4.1 Combined Impacts of All Stressors

As described in Section 3.0.5.5 (Resource-Specific Impacts Analysis for Multiple Stressors), this section evaluates the potential for combined impacts of all stressors from the Proposed Action. Analysis and conclusions for the potential impacts from each of the individual stressors are discussed in the sections above and summarized in Sections 3.8.4.2 (Endangered Species Act Determinations) and 3.8.4.3 (Essential Fish Habitat 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. This analysis makes the reasonable assumption that the majority of exposures to stressors are non-lethal, and instead focuses on consequences potentially impacting the organism's fitness (e.g., physiology, behavior, reproductive potential).

It is unlikely that mobile or migratory marine invertebrates that occur within the water column would be exposed to multiple activities during their lifespan because they are relatively short-lived, and most Navy training and testing activities impact small, widely-dispersed areas. It is much more likely that stationary organisms or those that only move over a small range (e.g., corals, worms, and sea urchins) would be exposed to multiple activities because many Navy activities recur in the same location (e.g., gunnery and mine warfare).

Multiple stressors can co-occur with marine invertebrates in two general ways. The first would be if a marine invertebrate were exposed to multiple sources of stress from a single event or activity. The second is exposure to a combination of stressors over the course of the organism's life. Both general scenarios are more likely to occur where training and testing activities are concentrated (e.g., in the vicinity of Naval Stations Norfolk and Mayport, the gunnery box in the JAX Range Complex, the Undersea Warfare Training Range, and the Naval Surface Warfare Center, Panama City Division and Naval Undersea Warfare Center Division, Newport Testing Ranges). The key difference between the two scenarios is the amount of time between exposures to stressors. Time is an important factor because some stressors develop over a long period while others occur and pass quickly (e.g., dissolution of secondary stressors into the sediment versus physical disturbance). Similarly, time is an important factor for the organism 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.

Marine invertebrates are susceptible to multiple stressors (Section 3.8.2.2, General Threats), and susceptibilities of many species are enhanced by additive or synergistic effects of multiple stressors (Section 3.8.2.9, Corals, Hydroids, Jellyfish [Phylum Cnidaria]). The global decline of corals, for example, is driven primarily by synergistic impacts of pollution, ecological consequences of overfishing, and climate change (Section 3.8.2.15.1, Shallow-Water Coral). As discussed in the analyses above, marine invertebrates are not particularly susceptible to energy, entanglement, or ingestion stressors resulting from Navy activities (Section 3.8.3.2, Energy Stressors; Section 3.8.3.4, Entanglement Stressors; and Section 3.8.3.5, Ingestion Stressors); therefore, the opportunity for Navy stressors to result in additive or synergistic consequences is most likely limited to acoustic, physical strike and disturbance, and secondary stressors.

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. Particularly susceptible habitat-forming marine invertebrates co-occur with multiple training and testing activities in the Jacksonville Range Complex gunnery box and the Undersea Warfare Training Range. However, analyses of the nature of potential consequences of combined impacts of all stressors on marine invertebrates remain largely qualitative and speculative. Where multiple stressors coincide with marine invertebrates, the likelihood of a negative consequence is elevated, but it is not feasible to predict the nature of the consequence or its likelihood because not enough is known about potential additive or synergistic interactions. Even for shallow-water coral reefs, an exceptionally well-studied resource, predictions of the consequences of multiple stressors are semi-quantitative and generalized predictions remain qualitative (Hughes and Connell 1999; Jackson 2008; Norström et al. 2009). It is also possible that Navy stressors would combine with non-Navy stressors, and this is qualitatively discussed in the Cumulative Impacts chapter (Chapter 4).

3.8.4.2 Endangered Species Act Determinations

Table 3.8-5 summarizes the Navy's determination of effect on ESA-listed and ESA-proposed marine invertebrates. Pursuant to the ESA, the Navy has undertaken Section 7 consultation with NMFS for the proposed and ongoing activities in the AFTT Study Area under Alternative 2 (Preferred Alternative). Accordingly, the Navy included elkhorn coral (*Acropora palmata*), staghorn coral (*Acropora cervicornis*), boulder star coral (*Montastraea annularis*), mountainous star coral (*Montastraea faveolata*), pillar coral (*Dendrogyra cylindrus*), rough cactus coral (*Mycetophyllia ferox*), star coral (*Montastraea franksi*), elliptical star coral (*Dichocoenia stokesii*), and Lamarck's sheet coral (*Agaricia lamarcki*), in the Section 7 ESA consultation with NMFS. No other ESA-listed invertebrate species occur within the Study Area.

Primary constituent elements for elkhorn and staghorn coral critical habitat are defined in Sections 3.8.2.3.1 and 3.8.2.4.1 (Status and Management) and important physical and biological characteristics of elkhorn and staghorn coral habitat are defined in Sections 3.8.2.3.2 and 3.8.2.4.2 (Habitat and Geographic Range). Exemptions from critical habitat designations include a small zone around Naval Air Station Key West, and the South Florida Ocean Measurement Facility Testing Range (Sections 3.8.2.3.1 and 3.8.2.4.1, Status and Management). All activities involving military expended materials, seafloor devices, and secondary stressors in the Key West Range Complex and the South Florida Ocean Measurement Facility Testing Range could expose this substrate to disturbances that could degrade the quality of critical habitat. However, the likelihood of exposure is reduced by mitigation measures, discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring). It is unlikely that activities involving military expended materials, seafloor devices, and secondary stressors would reduce the conservation value of elkhorn and staghorn coral critical habitat.

3.8.4.3 Essential Fish Habitat Determinations

Pursuant to the Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of sonar and other acoustic sources, vessel noise, swimmer defense airguns, weapons firing noise, high energy lasers, vessel movement, in-water devices, and metal, chemical, or other material contaminants will have no adverse effect on sedentary invertebrate beds or reefs that constitute Essential Fish Habitat or Habitat Areas of Particular Concern. The use of explosives, pile driving, electromagnetic sources, military expended materials, seafloor devices, and explosives and explosive byproduct contaminants may have an adverse effect on Essential Fish Habitat by reducing the quality and quantity of sedentary invertebrate beds or reefs that constitute

Essential Fish Habitat or Habitat Areas of Particular Concern. The AFTT Essential Fish Habitat Assessment states that individual stressor impacts were all either no-effect, or minimal and ranged in duration from temporary to permanent, depending on the stressor (U.S. Department of the Navy 2013).

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Table 3.8-5: Summary of Endangered Species Act Determinations for Marine Invertebrates for the Preferred Alternative

Stressor		Elkhorn Coral	Staghorn Coral	Boulder Star Coral	Mountainous Star Coral	Pillar Coral	Rough Cactus Coral	Star Coral	Elliptical Star Coral	Lamarck's Sheet Coral
Acoustic Stressors										
Sonar and Other Acoustic Sources	Training activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
	Testing activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Explosives	Training activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
	Testing activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Pile Driving	Training activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
	Testing activities	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Swimmer Defense Airguns	Training activities	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	Testing activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Weapons Firing, Launch, and Impact Noise	Training activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
	Testing activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Vessel Noise	Training activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
	Testing activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Aircraft Noise	Training activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
	Testing activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Energy Stressors										
Electromagnetic Devices	Training activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
	Testing activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
High Energy Lasers	Training activities	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	Testing activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Physical Disturbance and Strike Stressors										
Vessels and In-Water Devices	Training activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
	Testing activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Military Expended Materials	Training activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
	Testing activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
Seafloor Devices	Training activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
	Testing activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
Entanglement Stressors										
Fiber Optic Cables and Guidance Wires	Training activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
	Testing activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Parachutes	Training activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
	Testing activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Ingestion Stressors										
Munitions	Training activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
	Testing activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Military Expended Materials Other Than Munitions	Training activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
	Testing activities	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect	No effect
Secondary Stressors										
Secondary Stressors	Training activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
	Testing activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect

NOTE: The scientific names of the listed species are as follows: elkhorn coral (*Acropora palmata*), staghorn coral (*Acropora cervicornis*), pillar coral (*Dendrogyra cylindrus*), boulder star coral (*Montastraea annularis*), mountainous star coral (*Montastraea faveolata*), star coral (*Montastraea franksi*), rough cactus coral (*Mycetophyllia ferox*), Lamarck's sheet coral (*Agaricia lamarcki*), and elliptical star coral (*Dichocoenia stokesii*).

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3.9 FISH

FISH SYNOPSIS

The Navy considered all potential stressors and the following were analyzed for fish:

- Acoustic (sonar and other non-impulsive acoustic sources, and explosives and other impulsive acoustic sources)
- Energy (electromagnetic devices, high energy lasers)
- Physical disturbance and strikes (vessels and in-water devices, military expended materials, and seafloor devices)
- Entanglement (fiber optic cables and guidance wires, parachutes)
- Ingestion (munitions and military expended materials other than munitions)
- Secondary (explosives and explosion byproducts, metals, chemicals, and other materials)

Alternative 2 (Preferred Alternative)

- Acoustic: Pursuant to the Endangered Species Act (ESA), the use of sonar and other non-impulsive acoustic sources may affect but is not likely to adversely affect ESA-listed fish species; will have no effect on Atlantic salmon or smalltooth sawfish critical habitat; and may affect but is not likely to adversely affect Gulf sturgeon critical habitat.

  Pursuant to the ESA, the use of explosives and other impulsive acoustic sources may affect and is likely to adversely affect ESA-listed Atlantic sturgeon, Gulf sturgeon, and smalltooth sawfish; may affect but is not likely to adversely affect the Atlantic salmon, largetooth sawfish, and shortnose sturgeon; will have no effect on Atlantic salmon or smalltooth sawfish critical habitat; and may affect but is not likely to adversely affect Gulf sturgeon critical habitat.
- Energy: Pursuant to the ESA, the use of electromagnetic devices during training and testing activities may affect but is not likely to adversely affect ESA-listed largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Gulf sturgeon, and Atlantic sturgeon; will have no effect on Atlantic salmon; will have no effect on Atlantic salmon or smalltooth sawfish critical habitat; and may affect but is not likely to adversely affect Gulf sturgeon critical habitat. Pursuant to the ESA, the use of high energy lasers will have no effect on ESA-listed fish species; and will have no effect on Atlantic salmon, smalltooth sawfish, or Gulf sturgeon critical habitat.
- Physical Disturbance and Strikes: Pursuant to the ESA, the use of vessels, in-water devices, military expended materials, and seafloor devices may affect but is not likely to adversely affect ESA-listed fish species; may affect but is not likely to adversely affect Gulf sturgeon critical habitat; and will have no effect on Atlantic salmon and smalltooth sawfish critical habitat.
- Entanglement: Pursuant to the ESA, the use of fiber optic cables, guidance wires, and parachutes may affect but is not likely to adversely affect ESA-listed fish species.
- Ingestion: Pursuant to the ESA, the potential for ingestion of military expended materials may affect but is not likely to adversely affect ESA-listed fish species.
- Secondary Stressors: Pursuant to the ESA, secondary stressors may affect but are not likely to adversely affect ESA-listed fish species and will have no effect on Atlantic salmon, smalltooth sawfish, and Gulf sturgeon critical habitat.
- Pursuant to the Essential Fish Habitat requirements, the use of sonar and other active acoustic sources (Atlantic herring only), explosives, pile driving, and electromagnetic devices may have a minimal and temporary adverse effect on the fishes that occupy water column Essential Fish Habitat.

3.9.1 INTRODUCTION

This section analyzes the potential impacts of the Proposed Action on fish found in the Study Area. Section 3.9.1 (Introduction) introduces the Endangered Species Act (ESA) species and taxonomic groups that occur in the Study Area. Section 3.9.2 (Affected Environment) discusses the baseline affected environment. The complete analysis of environmental consequences is in Section 3.9.3 (Environmental Consequences) and the potential impacts of the Proposed Action on marine fish species are summarized in Section 3.9.4 (Summary of Potential Impacts on Fish).

For this Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS), marine fish are evaluated as groups of species characterized by distribution, morphology (body type), or behavior relevant to the stressor being evaluated. Activities are evaluated for their potential effects on the marine fish in the Study Area that are listed, proposed, or candidate species under the ESA, as well as other fish in the Study Area generally by major marine fish groupings. Fish are not distributed uniformly throughout the Study Area but are closely associated with a variety of habitats. Some species, such as large sharks, salmon, tuna, and billfish, range across thousands of square miles. Other species, such as gobies and most reef fish, generally have small home ranges and restricted distributions (Helfman et al. 2009). The early life stages (e.g., eggs and larvae) of many fish may be widely distributed even when the adults have relatively small ranges. The movements of some open-ocean species may never overlap with coastal fish that spend their lives within several hundred feet (a few hundred meters) of the shore. The distribution and specific habitats in which an individual of a single fish species occurs may be influenced by its developmental stage, size, sex, reproductive condition, and other factors. There are more than 1,600 marine fish species in the Study Area, approximately 65 percent of which occur in the coastal zone. About 35 percent of the known species, including deep-sea fish, occur in the oceanic zone (Froese and Pauly 2010).

Marine fish species that are regulated under the Magnuson-Stevens Fishery Conservation and Management Act are listed in Section 3.9.1.3 (Major Marine Fish Groups). Additional general information on the biology, life history, distribution, and conservation of marine fish is available on the websites of the following agencies and organizations, as well as many others:

- National Marine Fisheries Service (NMFS), Office of Protected Resources (including ESA-listed species distribution maps)
- Regional Fishery Management Councils
    - New England Fishery Management Council
    - Mid-Atlantic Fishery Management Council
    - South Atlantic Fishery Management Council
    - Gulf of Mexico Fishery Management Council
    - Caribbean Fishery Management Council
- Regional Marine Fisheries Commissions
    - Atlantic States Marine Fisheries Commission
    - Gulf States Marine Fisheries Commission
- International Union for Conservation of Nature and Natural Resources
- FishBase: A Global Information System on Fish

3.9.1.1 Endangered Species Act Species

Six marine fish species in the Study Area are listed under the ESA: Atlantic salmon (*Salmo salar*), largetooth sawfish (*Pristis pristis*), smalltooth sawfish (*Pristis pectinata*), shortnose sturgeon (*Acipenser brevirostrum*), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), and Gulf sturgeon (*Acipenser oxyrinchus desotoi*). One fish species, the scalloped hammerhead shark (*Sphyrna lewini*), is proposed to be listed as threatened under the ESA for the central and southwest Atlantic distinct population segment only. The remaining Atlantic population is considered a species of concern. Seven additional fish species are candidates for listing by NMFS as threatened or endangered in the future: American eel (*Anguilla rostrata*), cusk (*Brosme brosme*), dusky shark (*Carcharhinus obscurus*), dwarf seahorse (*Hippocampus zosterae*), great hammerhead shark (*Sphyrna mokarran*), Nassau grouper (*Epinephelus striatus*), and river herring (*Alosa pseudoharengus* and *Alosa aestivalis*) (Table 3.9-1). NMFS manages most ESA-protected marine fish species, and it co-manages some species that move between freshwater and saltwater (e.g., Atlantic salmon, sturgeon) with the United States (U.S.) Fish and Wildlife Service. NMFS also manages a proactive conservation program that allows for a listing of "species of concern." Species of concern are those fish that, "NMFS has some concerns regarding status and threats, but for which insufficient information is available to indicate a need to list the species under the ESA" (National Marine Fisheries Service 2011). There are 19 fish species of concern in the Study Area. Species of concern status does not carry any procedural or substantive protections under the ESA, but these species are included in Table 3.9-1 for informational purposes.

The species-specific information in the following sections focuses on the federally managed species, the six species listed as endangered or threatened, and the seven species listed as candidates for listing. The species protected under the ESA warrant special attention because the unit of protection is the individual rather than the population.

3.9.1.2 Federally Managed Species

The fisheries of the United States are managed within a framework of overlapping international, federal, state, interstate, and tribal authorities. Individual states and territories generally have jurisdiction over fisheries in marine waters within 3 nm of their coast (9 nm in Texas and the gulf coast of Florida). Federal jurisdiction includes fisheries in marine waters inside the U.S. Exclusive Economic Zone, which encompasses the area from the outer boundary of state waters out to 200 nm offshore of any U.S. coastline, except where intersected closer than 200 nm by bordering countries (Federal Register [FR] 61 (85): 19390-19429, May 1, 1996).

Table 3.9-1: Status and Presence of Endangered Species Act Endangered, Threatened, Proposed, and Candidate Fish Species, and Species of Concern in the Study Area

Species Name and Regulatory Status			Presence in Study Area*		
Common Name	Scientific Name	Endangered Species Act Status	Open Ocean Area	Large Marine Ecosystem	Bays, Estuaries, and Rivers
Atlantic Salmon	*Salmo salar*	Endangered	Gulf Stream, Labrador Current	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf, West Greenland Shelf	Kennebec River Estuary (Bath, ME)
Largetooth Sawfish	*Pristis pristis*	Endangered	None	Gulf of Mexico[1]	St. Andrew Bay[1] (Panama City, FL); Pascagoula River Estuary[1]; Sabine Lake[1] (Beaumont, TX); Corpus Christi Bay[1] (Corpus Christi, TX)
Smalltooth Sawfish	*Pristis pectinata*	Endangered	None	Southeast U.S. Continental Shelf, Gulf of Mexico, Caribbean Sea	St. Andrew Bay (Panama City, FL); Pascagoula River Estuary, Sabine Lake (Beaumont, TX); Corpus Christi Bay (Corpus Christi, TX)
Shortnose Sturgeon	*Acipenser brevirostrum*	Endangered	None	Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Scotian Shelf	Kennebec River Estuary (Bath, ME); Narragansett Bay; Rhode Island Sound; Thames River Estuary (Groton, CT); Sandy Hook Bay; lower Chesapeake Bay; Beaufort Inlet Channel (Morehead City, NC); Cape Fear River (Wilmington, NC); Kings Bay; and St. Johns River (Jacksonville, FL)
Gulf Sturgeon	*Acipenser oxyrinchus desotoi*	Threatened	None	Gulf of Mexico	St. Andrew Bay (Panama City, FL); Pascagoula River Estuary
Atlantic Sturgeon	*Acipenser oxyrinchus oxyrinchus*	Endangered/ threatened	None	Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	Kennebec River Estuary (Bath, ME); Narragansett Bay; Rhode Island Sound; Thames River Estuary (Groton, CT); Sandy Hook Bay; lower Chesapeake Bay; Beaufort Inlet Channel (Morehead City, NC); Cape Fear River (Wilmington, NC); Kings Bay; and St. Johns River (Jacksonville, FL)

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*Presence in the Study Area is characterized by open-ocean oceanographic features (Labrador Current, North Atlantic Subtropical Gyre, and Gulf Stream) or by 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).

[1] Based on historical records only; the last documented sighting of largetooth sawfish in U.S. waters was in 1961.

Table 3.9-1: Status and Presence of Endangered Species Act Endangered, Threatened, Proposed, and Candidate Fish Species, and Species of Concern in the Study Area (Continued)

Species Name and Regulatory Status			Presence in Study Area*		
Common Name	Scientific Name	Endangered Species Act Status	Open Ocean Area	Large Marine Ecosystem	Bays, Estuaries, and Rivers
Scalloped Hammerhead Shark	*Sphyrna lewini*	Proposed threatened[2]	Gulf Stream, North Central Atlantic Gyre	Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Gulf of Mexico, Caribbean Sea	Lower Chesapeake Bay; Beaufort Inlet Channel (Morehead City, NC); Cape Fear River (Wilmington, NC); Kings Bay; and St. Johns River (Jacksonville, FL); St. Andrew Bay (Panama City, FL); Pascagoula River Estuary; Sabine Lake, (Beaumont, TX); Corpus Christi Bay (Corpus Christi, TX)
American Eel	*Anguilla rostrata*	Candidate (U.S. Fish & Wildlife Service)	Gulf Stream, North Central Atlantic Gyre, Labrador Current	All large marine ecosystems in the Study Area	All bays, estuaries, and rivers in the Study Area
Cusk	*Brosme brosme*	Candidate/ species of concern[3]	Gulf Stream, North Central Atlantic Gyre, Labrador Current	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf, West Greenland Shelf	None
Dusky Shark	*Carcharhinus obscurus*	Candidate[4]	Gulf Stream	Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Gulf of Mexico, Caribbean Sea	Kennebec River Estuary (Bath, ME); Narragansett Bay; Rhode Island Sound; Thames River Estuary (Groton, CT); Sandy Hook Bay; lower Chesapeake Bay; Beaufort Inlet Channel (Morehead City, NC); Cape Fear River (Wilmington, NC); Kings Bay; and St. Johns River (Jacksonville, FL); St. Andrew Bay (Panama City, FL); Pascagoula River Estuary; Sabine Lake, (Beaumont, TX); Corpus Christi Bay (Corpus Christi, TX)

CT: Connecticut; FL: Florida; GA: Georgia; ME: Maine; NC: North Carolina; NJ: New Jersey; RI: Rhode Island; TX: Texas; U.S.: United States

*Presence in the Study Area is characterized by open-ocean oceanographic features (Labrador Current, North Atlantic Subtropical Gyre, and Gulf Stream) or by 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).

[2] Central and Southwest Atlantic Distinct Population Segment only.

[3] Species of concern status does not carry any procedural or substantive protections under the ESA, but these species are included in Table 3.9-1 for informational purposes.

[4] Species write-up not included in Section 3.9.2 for this species as its status was recently updated. However, consultation with the National Marine Fisheries Service would occur for this species should it become ESA-listed.

Table 3.9-1: Status and Presence of Endangered Species Act Endangered, Threatened, Proposed, and Candidate Fish Species, and Species of Concern in the Study Area (Continued)

Species Name and Regulatory Status			Presence in Study Area*		
Common Name	Scientific Name	Endangered Species Act Status	Open Ocean Area	Large Marine Ecosystem	Bays, Estuaries, and Rivers
Dwarf Seahorse	*Hippocampus zosterae*	Candidate	None	Southeast U.S. Continental Shelf, Gulf of Mexico, Caribbean Sea	St. Johns River (Jacksonville, FL); St. Andrew Bay[1] (Panama City, FL); Pascagoula River Estuary; Sabine Lake (Beaumont, TX); Corpus Christi Bay (Corpus Christi, TX)
Great hammerhead shark	*Sphyrna mokarran*	Candidate[4]	Gulf Stream, North Central Atlantic Gyre	Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Gulf of Mexico, Caribbean Sea	Beaufort Inlet Channel (Morehead City, NC); Cape Fear River (Wilmington, NC); Kings Bay; and St. Johns River (Jacksonville, FL); St. Andrew Bay (Panama City, FL); Pascagoula River Estuary; Sabine Lake (Beaumont, TX); Corpus Christi Bay (Corpus Christi, TX)
Nassau Grouper	*Epinephelus striatus*	Candidate/ species of concern[3]	Gulf Stream	Southeast U.S. Continental Shelf, Gulf of Mexico, Caribbean Sea	None
River Herring (Alewife and Blueback Herring)	*Alosa pseudoharengus* and *Alosa aestivalis*	Candidate/ species of concern[3]	Gulf Stream	Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	Kennebec River Estuary (Bath, ME); Narragansett Bay; Rhode Island Sound; Thames River Estuary (Groton, CT); Sandy Hook Bay; lower Chesapeake Bay; Beaufort Inlet Channel (Morehead City, NC); Cape Fear River (Wilmington, NC); Kings Bay; and St. Johns River (Jacksonville, FL)
Alabama Shad	*Alosa alabamae*	Species of concern[3]	None	Gulf of Mexico	St. Andrew Bay (Panama City, FL)
Atlantic Bluefin Tuna	*Thunnus thynnus*	Species of concern[3]	Gulf Stream, North Central Atlantic Gyre	Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf, Gulf of Mexico, Caribbean Sea	None

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*Presence in the Study Area is characterized by open-ocean oceanographic features (Labrador Current, North Atlantic Subtropical Gyre, and Gulf Stream) or by 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).

[3] Species of concern status does not carry any procedural or substantive protections under the ESA, but these species are included in Table 3.9-1 for informational purposes

[4] Species write-up not included for this species in Section 3.9.2 because of recent status change in 2013. Consultation with NMFS would occur for this species should it become ESA-listed.

Table 3.9-1: Status and Presence of Endangered Species Act Endangered, Threatened, Proposed, and Candidate Fish Species, and Species of Concern in the Study Area (Continued)

Species Name and Regulatory Status			Presence in Study Area*		
Common Name	Scientific Name	Endangered Species Act Status	Open Ocean Area	Large Marine Ecosystem	Bays, Estuaries, and Rivers
Atlantic Halibut	*Hippoglossus hippoglossus*	Species of concern[3]	Gulf Stream, North Central Atlantic Gyre, Labrador Current	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf, West Greenland Shelf	None
Atlantic Wolffish	*Anarhichas lupus*	Species of concern[3]	Gulf Stream, North Central Atlantic Gyre, Labrador Current	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf, West Greenland Shelf	None
Key Silverside	*Menidia conchorum*	Species of concern[3]	None	Gulf of Mexico	None
Mangrove Rivulus	*Rivulus marmoratus*	Species of concern[3]	None	Southeast U.S. Continental Shelf, Gulf of Mexico, Caribbean Sea	None
Night Shark	*Carcharhinus signatus*	Species of concern[3]	Gulf Stream	Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Gulf of Mexico, Caribbean Sea	None
Opossum Pipefish	*Microphis brachyurus lineatus*	Species of concern[3]	None	Southeast U.S. Continental Shelf, Gulf of Mexico, Caribbean Sea	St. Andrew Bay (Panama City, FL); Pascagoula River Estuary; Sabine Lake (Beaumont, TX); Corpus Christi Bay (Corpus Christi, TX)
Porbeagle Shark	*Lamna nasus*	Species of concern[3]	Gulf Stream, North Central Atlantic Gyre, Labrador Current	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf, West Greenland Shelf	None

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*Presence in the Study Area is characterized by open-ocean oceanographic features (Labrador Current, North Atlantic Subtropical Gyre, and Gulf Stream) or by 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).

[3] Species of concern status does not carry any procedural or substantive protections under the ESA, but these species are included in Table 3.9-1 for informational purposes.

Table 3.9-1: Status and Presence of Endangered Species Act Endangered, Threatened, Proposed, and Candidate Fish Species, and Species of Concern in the Study Area (Continued)

Species Name and Regulatory Status			Presence in Study Area*		
Common Name	Scientific Name	Endangered Species Act Status	Open Ocean Area	Large Marine Ecosystem	Bays, Estuaries, and Rivers
Rainbow Smelt	*Osmerus mordax*	Species of concern[3]	None	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf	Kennebec River Estuary (Bath, ME); Narragansett Bay; Rhode Island Sound; Thames River Estuary (Groton, CT); Sandy Hook Bay
Sand tiger Shark	*Carcharias taurus*	Species of concern[3]	Gulf Stream	Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf, Gulf of Mexico, Caribbean Sea	Narragansett Bay; Rhode Island Sound; Thames River Estuary (Groton, CT); Sandy Hook Bay; lower Chesapeake Bay; Beaufort Inlet Channel (Morehead City, NC); Cape Fear River (Wilmington, NC); Kings Bay; and St. Johns River (Jacksonville, FL); St. Andrew Bay (Panama City, FL); Pascagoula River Estuary; Sabine Lake (Beaumont, TX); Corpus Christi Bay (Corpus Christi, TX)
Speckled Hind	*Epinephelus drummondhayi*	Species of concern[3]	Gulf Stream	Southeast U.S. Continental Shelf, Gulf of Mexico, Caribbean Sea	None
Striped Croaker	*Bairdiella sanctaeluciae*	Species of concern[3]	None	Southeast U.S. Continental Shelf, Caribbean Sea	None
Thorny Skate	*Amblyraja radiata*	Species of concern[3]	None	Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf, West Greenland Shelf	None
Warsaw Grouper	*Epinephelus nigritus*	Species of concern[3]	Gulf Stream	Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, Gulf of Mexico, Caribbean Sea	None

CT: Connecticut; FL: Florida; GA: Georgia; ME: Maine; NC: North Carolina; NJ: New Jersey; RI: Rhode Island; TX: Texas; U.S.: United States

*Presence in the Study Area is characterized by open-ocean oceanographic features (Labrador Current, North Atlantic Subtropical Gyre, and Gulf Stream) or by 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).

[3] Species of concern status does not carry any procedural or substantive protections under the ESA, but these species are included in Table 3.9-1 for informational purposes.

The Magnuson-Stevens Fishery Conservation and Management Act and Sustainable Fisheries Act (see Section 3.0.1.1 (Federal Statutes) led to the formation of eight fishery management councils that share authority with NMFS to manage and conserve the fisheries in federal waters. Essential Fish Habitat is also identified and managed under this act. For analyses of impacts on those habitats included as Essential Fish Habitat within the Study Area, refer to Sections 3.3 (Marine Habitats), 3.7 (Marine Vegetation), and 3.8 (Marine Invertebrates). Together with NMFS, the councils maintain fishery management plans for species or species groups to regulate commercial and recreational fishing within their geographic regions. The Study Area overlaps the jurisdiction of five regional fishery management councils, as well as the range of the highly migratory species, which is managed by NMFS.

- **New England Fishery Management Council** includes Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut.
- **Mid-Atlantic Fishery Management Council** includes New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and North Carolina (from its northern border to Cape Hatteras).
- **South Atlantic Fishery Management Council** includes North Carolina (from Cape Hatteras to its southern border), South Carolina, Georgia, and the east coast of Florida.
- **Gulf of Mexico Fishery Management Council** includes west coast of Florida, Alabama, Mississippi, Louisiana, and Texas.
- **Caribbean Fishery Management Council** includes the Commonwealth of Puerto Rico and the U.S. Virgin Islands.
- **NMFS, Office of Sustainable Fisheries** includes all federally managed waters of the United States where highly migratory species occur.

Federally managed marine fish species are listed in Table 3.9-2. These species are included in the list of fish in Table 3.9-3, but are also given consideration as recreationally and commercially important species in the analysis of impacts in Section 3.9.3 (Environmental Consequences). The analysis of impacts on commercial and recreational fisheries is provided in Section 3.11 (Socioeconomic Resources).

3.9.1.3 Major Marine Fish Groups

Groups of marine fish are provided in Table 3.9-3 and are described further in Section 3.9.2 (Affected Environment), to supplement information on fish of the Study Area beyond the ESA-protected species in this document. These fish groups are based on the organization presented in Helfman et al. (2009), Moyle and Cech (1996), and Nelson (2006). These groupings are intended to organize the extensive and diverse list of fish that occur in the Study Area, as a means to structure the analysis of potential impacts on fish with similar ecological niches, behavioral characteristics, and habitat preferences. Exceptions to these generalizations exist within each group, and are noted wherever appropriate in the analysis of potential impacts.

Table 3.9-2: Federally Managed Fish Species within the Study Area, Listed by Regional Management Council under Each Fishery Management Plan

New England Fishery Management Council	
Common Name	**Scientific Name**
New England Multispecies Fishery Management Plan	
American Plaice	*Hippoglossoides platessoides*
Atlantic Cod	*Gadus morhua*
Atlantic Halibut	*Hippoglossus hippoglossus*
Haddock	*Melanogrammus aeglefinus*
Ocean Pout	*Zoarces americanus*
Offshore Hake	*Merluccius albidus*
Pollock	*Pollachius virens*
Red Hake	*Urophycis chuss*
Redfish	*Sebastes* spp.
Silver Hake/Whiting	*Merluccius bilinearis*
White Hake	*Urophycis tenuis*
Windowpane Flounder	*Scophthalmus aquosus*
Winter Flounder	*Pseudopleuronectes americanus*
Witch Flounder	*Glyptocephalus cynoglossus*
Yellowtail Flounder	*Limanda ferruginea*
New England Skate Fishery Management Plan	
Barndoor Skate	*Dipturus laevis*
Clearnose Skate	*Raja eglanteria*
Little Skate	*Leucoraja erinacea*
Rosette Skate	*Leucoraja garmani virginica*
Smooth Skate	*Malacoraja senta*
Thorny Skate	*Amblyraja radiata*
Winter Skate	*Leucoraja ocellata*
Atlantic Salmon Fishery Management Plan	
Atlantic Salmon	*Salmo salar*
Atlantic Herring Fishery Management Plan	
Atlantic Herring	*Clupea harengus*
Monkfish Fishery Management Plan	
Goosefish/Monkfish	*Lophius americanus*

Table 3.9-2: Federally Managed Fish Species within the Study Area, Listed by Regional Management Council under Each Fishery Management Plan (Continued)

Mid-Atlantic Fishery Management Council	
Common Name	**Scientific Name**
Summer Flounder, Scup, and Black Sea Bass Fishery Management Plan	
Black Sea Bass	*Centropristis striata*
Scup	*Stenotomus chrysops*
Summer Flounder	*Paralichthys dentatus*
Atlantic Bluefish Fishery Management Plan	
Bluefish	*Pomatomus saltatrix*
Atlantic Mackerel, Squid, and Butterfish Fishery Management Plan	
Atlantic Mackerel	*Scomber scombrus*
Butterfish	*Peprilus triacanthus*
Tilefish Fishery Management Plan	
Tilefish	*Lopholatilus chamaeleonticeps*
Spiny Dogfish Fishery Management Plan	
Spiny Dogfish	*Squalus acanthias*

South Atlantic Fishery Management Council	
Common Name	**Scientific Name**
Coastal Migratory Pelagics Fishery Management Plan	
Cero	*Scomberomorus regalis*
Cobia	*Rachycentron canadum*
King Mackerel	*Scomberomorus cavalla*
Little Tunny	*Euthynnus alletteratus*
Spanish Mackerel	*Scomberomorus maculatus*
Dolphin-Wahoo Fishery Management Plan	
Dolphinfish	*Coryphaena hippurus*
Pompano Dolphinfish	*Coryphaena equiselis*
Wahoo	*Acanthocybium solandri*
Snapper-Grouper Fishery Management Plan	
Almaco Jack	*Seriola rivoliana*
Atlantic Spadefish	*Chaetodipterus faber*
Banded Rudderfish	*Seriola zonata*
Bank Sea Bass	*Centropristis ocyurus*
Bar Jack	*Caranx ruber*
Black Grouper	*Mycteroperca bonaci*
Black Sea Bass	*Centropristis striata*
Black Snapper	*Apsilus dentatus*
Blackfin Snapper	*Lutjanus buccanella*
Blue Runner	*Caranx crysos*
Blueline Tilefish	*Caulolatilus microps*

Table 3.9-2: Federally Managed Fish Species within the Study Area, Listed by Regional Management Council under Each Fishery Management Plan (Continued)

South Atlantic Fishery Management Council (Continued)	
Common Name	**Scientific Name**
Coney	*Cephalopholis fulva*
Cottonwick	*Haemulon melanurum*
Cubera Snapper	*Lutjanus cyanopterus*
Dog Snapper	*Lutjanus jocu*
Gag	*Mycteroperca microlepis*
Goliath Grouper/Jewfish	*Epinephelus itajara*
Gray Snapper/Mangrove Snapper	*Lutjanus griseus*
Gray Triggerfish	*Balistes capriscus*
Graysby	*Cephalopholis cruentata*
Greater Amberjack	*Seriola dumerili*
Hogfish	*Lachnolaimus maximus*
Jolthead Porgy	*Calamus bajonado*
Knobbed Porgy	*Calamus nodosus*
Lane Snapper	*Lutjanus synagris*
Lesser Amberjack	*Seriola fasciata*
Longspine Porgy	*Stenotomus caprinus*
Mahogany Snapper	*Lutjanus mahogoni*
Margate	*Haemulon album*
Misty Grouper	*Epinephelus mystacinus*
Mutton Snapper	*Lutjanus analis*
Nassau Grouper	*Epinephelus striatus*
Ocean Triggerfish	*Canthidermis sufflamen*
Queen Triggerfish	*Balistes vetula*
Red Grouper	*Epinephelus morio*
Red Hind	*Epinephelus guttatus*
Red Porgy	*Pagrus pagrus*
Red Snapper	*Lutjanus campechanus*
Rock Hind	*Epinephelus adscensionis*
Rock Sea Bass	*Centropristis philadelphica*
Sailor’s Choice	*Haemulon parra*
Sand Tilefish	*Malacanthus plumieri*
Saucereye Porgy	*Calamus calamus*
Scamp	*Mycteroperca phenax*
Schoolmaster	*Lutjanus apodus*
Scup	*Stenotomus chrysops*
Silk Snapper	*Lutjanus vivanus*
Snowy Grouper	*Epinephelus niveatus*
Speckled Hind	*Epinephelus drummondhayi*
Tilefish	*Lopholatilus chamaeleonticeps*

Table 3.9-2: Federally Managed Fish Species within the Study Area, Listed by Regional Management Council under Each Fishery Management Plan (Continued)

South Atlantic Fishery Management Council (Continued)	
Common Name	**Scientific Name**
Tomtate	*Haemulon aurolineatum*
Vermilion Snapper	*Rhomboplites aurorubens*
Warsaw Grouper	*Epinephelus nigritus*
White Grunt	*Haemulon plumierii*
Whitebone Porgy	*Calamus leucosteus*
Wreckfish	*Polyprion americanus*
Yellowedge Grouper	*Epinephelus flavolimbatus*
Yellowfin Grouper	*Mycteroperca venenosa*
Yellowmouth Grouper	*Mycteroperca interstitialis*
Yellowtail Snapper	*Ocyurus chrysurus*

Gulf of Mexico Fishery Management Council	
Common Name	**Scientific Name**
Reef Fish Resources of the Gulf of Mexico Fishery Management Plan	
Almaco Jack	*Seriola rivoliana*
Banded Rudderfish	*Seriola zonata*
Black Grouper	*Mycteroperca bonaci*
Blackfin Snapper	*Lutjanus buccanella*
Blueline Tilefish	*Caulolatilus microps*
Cubera Snapper	*Lutjanus cyanopterus*
Gag	*Mycteroperca microlepis*
Goldface Tilefish	*Caulolatilus chrysops*
Goliath Grouper/Jewfish	*Epinephelus itajara*
Gray Snapper/Mangrove Snapper	*Lutjanus griseus*
Gray Triggerfish	*Balistes capriscus*
Greater Amberjack	*Seriola dumerili*
Hogfish	*Lachnolaimus maximus*
Lane Snapper	*Lutjanus synagris*
Lesser Amberjack	*Seriola fasciata*
Mutton Snapper	*Lutjanus analis*
Nassau Grouper	*Epinephelus striatus*
Queen Snapper	*Etelis oculatus*
Red Grouper	*Epinephelus morio*
Red Snapper	*Lutjanus campechanus*
Scamp	*Mycteroperca phenax*
Silk Snapper	*Lutjanus vivanus*
Snowy Grouper	*Epinephelus niveatus*
Speckled Hind	*Epinephelus drummondhayi*

Table 3.9-2: Federally Managed Fish Species within the Study Area, Listed by Regional Management Council under Each Fishery Management Plan (Continued)

Gulf of Mexico Fishery Management Council (Continued)	
Common Name	**Scientific Name**
Tilefish	*Lopholatilus chamaeleonticeps*
Vermilion Snapper	*Rhomboplites aurorubens*
Warsaw Grouper	*Epinephelus nigritus*
Wenchman	*Pristipomoides aquilonaris*
Yellowedge Grouper	*Epinephelus flavolimbatus*
Yellowfin Grouper	*Mycteroperca venenosa*
Yellowmouth Grouper	*Mycteroperca interstitialis*
Yellowtail Snapper	*Ocyurus chrysurus*
Gulf of Mexico Red Drum Fishery Management Plan	
Red Drum	*Sciaenops ocellatus*
Coastal Migratory Pelagics of the Gulf of Mexico and South Atlantic Fishery Management Plan	
Bluefish	*Pomatomus saltatrix*
Cero Mackerel	*Scomberomorus regalis*
Cobia	*Rachycentron canadum*
Dolphinfish	*Coryphaena hippurus*
King Mackerel	*Scomberomorus cavalla*
Little tunny	*Euthynnus alletteratus*
Spanish Mackerel	*Scomberomorus maculatus*

Caribbean Fishery Management Council	
Common Name	**Scientific Name**
Caribbean Reef Fish Fishery Management Plan	
Almaco Jack	*Seriola rivoliana*
Atlantic Spadefish	*Chaetodipterus faber*
Banded Butterflyfish[1]	*Chaetodon striatus*
Bar Jack	*Caranx ruber*
Batfish[1]	*Ogcocepahalus* spp.
Beaugregory[1]	*Pomacentrus leucostictus*
Bicolor Damselfish[1]	*Pomacentrus partitus*
Bigeye	*Priacanthus arenatus*
Black Durgon	*Melichthys niger*
Black Jack	*Caranx lugubris*
Black Snapper	*Apsilus dentatus*
Blackbar Soldierfish[1]	*Myripristis jacobus*
Blackfin Snapper	*Lutjanus buccanella*

[1] These species were deleted from the fishery management unit proposed in Section 4.1.1 in the Comprehensive Amendment of the Fishery Management Plans of the U.S. Caribbean to Address Required Provisions of the Magnuson-Stevens Fishery Conservation and Management Act (Caribbean Fishery Management Council 2004).

Table 3.9-2: Federally Managed Fish Species within the Study Area, Listed by Regional Management Council under Each Fishery Management Plan (Continued)

Caribbean Fishery Management Council (Continued)	
Common Name	**Scientific Name**
Blackline Tilefish	*Caulolatilus cyanops*
Blue Chromis[1]	*Chromis cyanea*
Blue Parrotfish	*Scarus coeruleus*
Foureye Butterflyfish[1]	*Chaetodon capistratus*
French Angelfish[1]	*Pomacanthus paru*
French Grunt	*Haemulon flavolineatum*
Frogfish[1]	*Antennarius* spp.
Glasseye Snapper	*Priacanthus cruentatus*
Goldentail Moray[1]	*Gymnothorax miliaris*
Goldspotted Eel[1]	*Myrichthys ocellatus*
Goliath Grouper	*Epinephelus itajara*
Gray Angelfish	*Pomacanthus arcuatus*
Gray Snapper	*Lutjanus griseus*
Graysby	*Epinephelus cruentatus*
Greater Amberjack	*Seriola dumerili*
Greater Soapfish	*Rypticus saponaceus*
Green Moray[1]	*Gymnothorax funebris*
Green Razorfish[1]	*Hemipteronotus splendens*
Harlequin Bass[1]	*Serranus tigrinus*
High-Hat[1]	*Equetus acuminatus*
Hogfish	*Lachnolaimus maximus*
Honeycomb Cowfish	*Lactophrys polygonia*
Horse-Eye Jack	*Caranx latus*
Jackknife-Fish[1]	*Equetus lanceolatus*
Jolthead Porgy	*Calamus bajonado*
Lane Snapper	*Lutjanus synagris*
Lantern Bass	*Serranus baldwini*
Longsnout Butterflyfish[1]	*Chaetodon aculeatus*
Longspine Squirrelfish	*Holocentrus rufus*
Mahogany Snapper	*Lutjanus mahogani*
Margate	*Haemulon album*
Midnight Parrotfish	*Scarus coelestinus*
Misty Grouper	*Epinephelus mystacinus*
Mutton Snapper	*Lutjanus analis*
Nassau Grouper	*Epinephelus striatus*
Neon Goby[1]	*Gobiosoma oceanops*
Ocean Surgeonfish	*Acanthurus bahianus*
Ocean Triggerfish	*Canthidermis sufflamen*

[1] These species were deleted from the fishery management unit proposed in Section 4.1.1 in the Comprehensive Amendment of the Fishery Management Plans of the U.S. Caribbean to Address Required Provisions of the Magnuson-Stevens Fishery Conservation and Management Act (Caribbean Fishery Management Council 2004).

Table 3.9-2: Federally Managed Fish Species within the Study Area, Listed by Regional Management Council under Each Fishery Management Plan (Continued)

Caribbean Fishery Management Council (Continued)	
Common Name	**Scientific Name**
Orangeback Bass	*Serranus annularis*
Peacock Flounder [1]	*Bothus lunatus*
Pearly Razorfish[1]	*Hemipteronotus novacula*
Pipefish[1]	*Syngnathus* spp.
Pluma	*Calamus pennatula*
Porcupinefish[1]	*Diodon hystrix*
Porkfish	*Anisotremus virginicus*
Princess Parrotfish	*Scarus taeniopterus*
Puddingwife[1]	*Halichoeres radiatus*
Queen Angelfish	*Holacanthus ciliaris*
Queen Parrotfish	*Scarus vetula*
Queen Snapper	*Etelis oculatus*
Queen Triggerfish	*Balistes vetula*
Rainbow Parrotfish	*Scarus guacamaia*
Red Grouper	*Epinephelus morio*
Red Hind	*Epinephelus guttatus*
Redband Parrotfish	*Sparisoma aurofrenatum*
Redfin Parrotfish	*Sparisoma rubripinne*
Redlip Blenny[1]	*Ophioblennius atlanticus*
Redspotted Hawkfish[1]	*Amblycirrhitus pinos*
Redtail Parrotfish	*Sparisoma chrysopterum*
Rock Beauty[1]	*Holacanthus tricolor*
Rock Hind	*Epinephelus adscensionis*
Royal Gramma[1]	*Gramma loreto*
Rusty Goby[1]	*Priolepis hipoliti*
Sand Diver	*Synodus intermedius*
Sand Tilefish	*Malacanthus plumieri*
Sargassum Triggerfish[1]	*Xanthichthys rigens*
Schoolmaster	*Lutjanus apodus*
Scrawled Cowfish	*Lactophrys quadricornis*
Scrawled Filefish	*Aluterus scriptus*
Sea Bream	*Archosargus rhomboidalis*
Seahorses[1]	*Hippocampus* spp.
Sergeant Major	*Abudefduf saxatilis*
Sharpnose Puffer[1]	*Canthigaster rostrata*
Sheepshead Porgy	*Calamus penna*
Silk Snapper	*Lutjanus vivanus*
Smooth Trunkfish	*Lactophrys triqueter*

[1] These species were deleted from the fishery management unit proposed in Section 4.1.1 in the Comprehensive Amendment of the Fishery Management Plans of the U.S. Caribbean to Address Required Provisions of the Magnuson-Stevens Fishery Conservation and Management Act (Caribbean Fishery Management Council 2004).

Table 3.9-2: Federally Managed Fish Species within the Study Area, Listed by Regional Management Council under Each Fishery Management Plan (Continued)

Caribbean Fishery Management Council (Continued)	
Common Name	**Scientific Name**
Spanish Hogfish[1]	*Bodianus rufus*
Spotfin Butterflyfish[1]	*Chaetodon ocellatus*
Spotted Drum[1]	*Equetus punctatus*
Spotted Goatfish	*Pseudupeneus maculatus*
Spotted Trunkfish	*Lactophrys bicaudalis*
Squirrelfish	*Holocentrus adscensionis*
Stoplight Parrotfish	*Sparisoma viride*
Striped Parrotfish	*Scarus croicensis*
Sunshinefish[1]	*Chromis insolata*
Swissguard Basslet[1]	*Liopropoma rubre*
Threespot Damselfish[1]	*Pomacentrus planifrons*
Tiger Grouper	*Mycteroperca tigris*
Tobaccofish	*Serranus tabacarius*
Tomtate	*Haemulon aurolineatum*
Trumpetfish[1]	*Aulostomus maculatus*
Trunkfish	*Lactophrys trigonus*
Vermilion Snapper	*Rhomboplites aurorubens*
Wenchman	*Pristipomoides aquilonaris*
White Grunt	*Haemulon plumieri*
Whitespotted Filefish	*Cantherhines macrocerus*
Yellow Goatfish	*Mulloidichthys martinicus*
Yellow jack	*Caranx bartholomaei*
Yellowcheek Wrasse[1]	*Halichoeres cyanocephalus*
Yellowedge Grouper	*Epinephelus flavolimbatus*
Yellowfin Grouper	*Mycteroperca venenosa*
Yellowhead Jawfish[1]	*Opistognathus aurifrons*
Yellowhead Wrasse[1]	*Halichoeres garnoti*
Yellowtail Damselfish[1]	*Microspathodon chrysurus*
Yellowtail Snapper	*Ocyurus chrysurus*

[1] These species were deleted from the fishery management unit proposed in Section 4.1.1 in the Comprehensive Amendment of the Fishery Management Plans of the U.S. Caribbean to Address Required Provisions of the Magnuson-Stevens Fishery Conservation and Management Act (Caribbean Fishery Management Council 2004).

Table 3.9-2: Federally Managed Fish Species within the Study Area, Listed by Regional Management Council under Each Fishery Management Plan (Continued)

National Marine Fisheries Service (Continued)	
Common Name	**Scientific Name**
Consolidated Highly Migratory Species Fishery Management Plan	
Tuna Fishery Management Unit	
Albacore Tuna	*Thunnus alalunga*
Bigeye Tuna	*Thunnus obesus*
Bluefin Tuna	*Thunnus thynnus*
Skipjack Tuna	*Katsuwonus pelamis*
Yellowfin Tuna	*Thunnus albacares*
Swordfish Fishery Management Unit	
Swordfish	*Xiphias gladius*
Billfish Fishery Management Unit	
Blue Marlin	*Makaira nigricans*
Longbill Spearfish	*Tetrapturus pfluegeri*
Sailfish	*Istiophorus platypterus*
White Marlin	*Tetrapturus albidus*
Large Coastal Sharks	
Blacktip Shark	*Carcharhinus limbatus*
Bull Shark	*Carcharhinus leucas*
Great Hammerhead Shark	*Sphyrna mokarran*
Nurse Shark	*Ginglymostoma cirratum*
Lemon Shark	*Negaprion brevirostris*
Sandbar Shark	*Carcharhinus plumbeus*
Scalloped Hammerhead Shark	*Sphyrna lewini*
Silky Shark	*Carcharhinus falciformis*
Smooth Hammerhead	*Sphyrna zygaena*
Spinner Shark	*Carcharhinus brevipinna*
Tiger Shark	*Galeocerdo cuvier*
Small Coastal Sharks	
Atlantic Sharpnose Shark	*Rhizoprionodon terraenovae*
Blacknose Shark	*Carcharhinus acronotus*
Bonnethead Shark	*Sphyrna tiburo*
Finetooth Shark	*Carcharhinus isodon*
Pelagic Sharks	
Blue Shark	*Prionace glauca*
Common Thresher Shark	*Alopias vulpinus*
Oceanic Whitetip Shark	*Carcharhinus longimanus*
Porbeagle Shark	*Lamna nasus*
Shortfin Mako Shark	*Isurus oxyrhinchus*

Table 3.9-2: Federally Managed Fish Species within the Study Area, Listed by Regional Management Council under Each Fishery Management Plan (Continued)

National Marine Fisheries Service (Continued)	
Common Name	**Scientific Name**
Prohibited Species[2]	
Atlantic Angel Shark	*Squatina dumeril*
Basking Shark	*Cetorhinus maximus*
Bigeye Thresher Shark	*Alopias superciliosus*
Bigeye Sandtiger Shark	*Odontaspis noronhai*
Bigeye Sixgill Shark	*Hexanchus nakamurai*
Bignose Shark	*Carcharhinus altimus*
Caribbean Reef Shark	*Carcharhinus perezii*
Caribbean Sharpnose Shark	*Rhizoprionodon porosus*
Dusky Shark	*Carcharhinus obscurus*
Galapagos Shark	*Carcharhinus galapagensis*
Longfin mako Shark	*Isurus paucus*
Narrowtooth Shark	*Carcharhinus brachyurus*
Night Shark	*Carcharhinus signatus*
Sand tiger Shark	*Carcharias taurus*
Sevengill Shark	*Heptranchias perlo*
Sixgill Shark	*Hexanchus griseus*
Smalltail Shark	*Carcharhinus porosus*
Whale Shark	*Rhincodon typus*
White Shark	*Carcharodon carcharias*

[2] Prohibited species are those sharks listed that commercial or recreational anglers cannot possess under current regulations.

Table 3.9-3: Major Groups of Marine Fish in the Study Area

Major Marine Fish Groups[1]		Vertical Distribution within Study Area[2]		
Group Names	**Description**	**Open Ocean**	**Large Marine Ecosystem**	**Bays, Estuaries, and Rivers**
Jawless Fish (Order Myxiniformes and Order Petromyzontiformes)	Primitive jawless fish with an eel-like body shape that feed on dead fish or are parasitic on other fish.	Water column, seafloor	Seafloor	Water column, bottom
Sharks, Skates, Rays, and Chimaeras (Class Chondrichthyes)	Cartilaginous (nonbony) fish, many of which are open-ocean predators.	Surface, water column, seafloor	Surface, water column, seafloor	Surface, water column, bottom
Sturgeons and Gars (Order Acipenseriformes and Order Lepisosteiformes)	Represent the oldest living group of bony fish; most sturgeon move into freshwater to spawn. Gars are primary freshwater fish that occasionally move into estuaries to feed.	None	Surface (occasional), water column, seafloor	Surface, water column, bottom
Eels and Bonefish (Order Anguilliformes and Order Elopiformes)	Undergo a unique willow leaf-shaped larval stage, with a small head and often an elongated body.	Surface, water column, seafloor	Surface, water column, seafloor	Surface, water column, bottom
Herrings (Order Clupeiformes)	Commercially valuable schooling plankton eaters, such as herrings, sardines, menhaden, and anchovies. Some herrings migrate between marine and estuarine and freshwater habitats.	Surface, water column	Surface, water column	Surface, water column
Smelts and Salmonids (Orders Argentiniformes, Osmeriformes, and Salmoniformes)	Most salmon and smelts migrate between marine and estuarine and freshwater habitats; Argentiniformes occur in deep waters.	Seafloor (Argen-tiniforme s only), surface, water column	Surface, water column	Surface, water column
Dragonfish and Lanternfish (Orders Stomiiformes and Myctophiformes)	Largest group of deepwater fish; some have adaptations for low-light conditions, including light-emitting capabilities.	Water column, seafloor	Water column, seafloor	None
Greeneyes, Lizardfish, Lancetfish, and Telescopefish (Order Aulopiformes)	Have both primitive and advanced features of marine fish; includes both coastal and estuarine species, as well as deepsea fish that occur in midwaters and along the bottom.	Seafloor	Water column, seafloor	Water column, seafloor
Cods and Cusk-Eels (Orders Gadiformes and Ophidiiformes)	Important commercial fisheries; associated with bottom habitats; includes some deepwater groups. Most have a distinctive barbel (a slender tactile organ) below the mouth.	Water column, seafloor	Water column, seafloor	Surface, water column

[1] Groups are not strictly taxonomic, but are based on the organization applied by (Helfman et al. 2009; Moyle and Cech 1996; Nelson 2006).

[2] Presence in the Study Area includes open ocean areas (portions of the North Atlantic Subtropical Gyre, Labrador Current, and Gulf Stream Current) and coastal waters of several 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. Representative species from all taxonomic groups occur in each open ocean area and large marine ecosystem; therefore, those areas are not identified in this table, but their vertical distribution within these areas is identified.

Table 3.9-3: Major Groups of Marine Fish in the Study Area (Continued)

Major Marine Fish Groups[1]		Vertical Distribution within Study Area[2]		
Group Names	**Description**	**Open Ocean**	**Large Marine Ecosystem**	**Bays, Estuaries, and Rivers**
Toadfish and Anglerfish (Orders Batrachoidiformes and Lophiiformes)	Includes the sound-producing toadfish and the anglerfish, classic lie-in-wait predators.	Seafloor	Seafloor	Bottom
Mullets, Silversides, Needlefish, and Killifish (Orders Mugiliformes, Atheriniformes, Beloniformes, and Cyprinodontiformes)	Small nearshore (within 3 nm of shoreline) fish that primarily feed on organic debris; also includes the surface-oriented flyingfish.	Surface	Surface, water column, seafloor	Surface, water column, bottom
Oarfish, Squirrelfish, Dories (Orders Lampridiformes, Beryciformes, Zeiformes)	Primarily open-ocean or deepwater fish, except for squirrelfish, which are reef-associated.	Surface, water column, seafloor	Surface, water column, seafloor	None
Pipefish and Seahorses (Order Gasterosteiformes)	Small mouth, with tubular snout and armor-like scales; males care for young in nests or pouches.	None	Surface, water column, seafloor	Surface, water column, bottom
Scorpionfish (Order Scorpaeniformes)	Bottom dwelling with modified pectoral fins to rest on the bottom. Many are venomous.	Seafloor	Seafloor	Seafloor
Drums, Snappers, Snooks, Temperate Basses, and Reef Fish (Order Perciformes[3], with Representative Families; Sciaenidae, Lutjanidae, Centropomidae, Moronidae, Apogonidae, Chaetodontidae, Pomacanthidae, and Mullidae)	Important gamefish and common predators in all marine waters; sciaenids produce sounds with their swim bladders.	Surface, water column, seafloor	Surface, water column, seafloor	Surface, water column, bottom
Groupers and Sea Basses (Order Perciformes[3], with Representative Families; Serranidae)	Important gamefish with vulnerable conservation status; in some species, individuals change from female to male as they mature.	Water column, seafloor	Surface, water column, seafloor	Surface, water column, seafloor
Wrasses and Parrotfish (Order Perciformes[3], with Representative Families; Labridae and Scaridae)	Primarily reef-associated fish; in some species, individuals change from female to make as they mature.	Water column, seafloor	Surface, water column, seafloor	Surface, water column, seafloor

[1] Groups are not strictly taxonomic, but are based on the organization applied by (Helfman et al. 2009; Moyle and Cech 1996; Nelson 2006).

[2] Presence in the Study Area includes open ocean areas (portions of the North Atlantic Subtropical Gyre, Labrador Current, and Gulf Stream Current) and coastal waters of several 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. Representative species from all taxonomic groups occur in each open ocean area and large marine ecosystem; therefore, those areas are not identified in this table, but their vertical distribution within these areas is identified.

[3] Order Perciformes includes approximately 40 percent of all bony fish and includes highly diverse fish. Representative families are included here to reflect this diversity.

Table 3.9-3: Major Groups of Marine Fish in the Study Area (Continued)

Major Marine Fish Groups[1]		Vertical Distribution within Study Area[2]		
Group Names	**Description**	**Open Ocean**	**Large Marine Ecosystem**	**Bays, Estuaries, and Rivers**
Gobies, Blennies, Damselfish (Order Perciformes[3], with Representative Suborders: Gobioidei, Blennioidei, and Acanthuroidei)	Gobies are the largest and most diverse family of marine fish, mostly found in bottom habitats of coastal areas.	Seafloor	Seafloor	Bottom
Jacks, Tunas, Mackerels, and Billfish (Order Perciformes[3], with Representative Families: Carangidae, Scombridae, Xiphiidae, and Istiophoridae)	Highly migratory predators found near the surface; commercially valuable fisheries.	Surface	Surface, water column	Surface, water column
Flounders (Order Pleuronectiformes)	Flatfish lack swim bladders, are well camouflaged, and occur in bottom habitats throughout the world.	Seafloor	Seafloor	Bottom
Triggerfish, Puffers, and Molas (Order Tetraodontiformes)	Unique body shapes and characteristics to deter predators (e.g., spines); includes ocean sunfish, the largest bony fish.	Surface, water column, seafloor	Surface, water column, seafloor	Surface, water column, seafloor

[1] Groups are not strictly taxonomic, but are based on the organization applied by Helfman et al. (2009); Moyle and Cech (1996); Nelson (2006).

[2] Presence in the Study Area includes open ocean areas (portions of the North Atlantic Subtropical Gyre, Labrador Current, and Gulf Stream Current) and coastal waters of several 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. Representative species from all taxonomic groups occur in each open ocean area and large marine ecosystem; therefore, those areas are not identified in this table, but their vertical distribution within these areas is identified.

[3] Order Perciformes includes approximately 40 percent of all bony fish and includes highly diverse fish. Representative families are included here to reflect this diversity.

3.9.2 AFFECTED ENVIRONMENT

Many factors impact the abundance and distribution of marine fish in the seven 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) and three open ocean areas (Labrador Sea, North Atlantic Subtropical Gyre, and Gulf Stream Current) in the Study Area. The distribution of fish species in the Study Area is influenced primarily by temperature, salinity, pH, physical habitat, ocean currents, and latitudinal gradients (Helfman et al. 2009; Macpherson 2002; Nelson 2006). In general terms, the coastal-centered large marine ecosystems support a greater diversity of coastal species, while the open ocean areas support a lower diversity of oceanic and deep-sea species (Helfman et al. 2009; Nelson 2006). The warm waters of the Loop Current in the Gulf of Mexico promote the dispersal of tropical species from the Caribbean Sea into the Northern Gulf of Mexico (Shulman 1985). The circulation patterns of the Gulf Stream and the North Atlantic Subtropical Gyre also influence species distributions, particularly near Bermuda, where the northernmost occurrences of sizable tropical fish assemblages are found (Love and Chase 2007; Moyle and Cech 1996). The Gulf Stream, described in Section 3.0.3 (Ecological Characterization of the Study Area), carries warm water to northern latitudes, where it can support subtropical species. For example, approximately half of the species occurrences in the Gulf of Maine are considered warm-water fish (Moyle and Cech 1996), although some of these are sporadic or rare.

Marine fish can also be broadly categorized into horizontal and vertical distributions within the water column. The primary ecological groups of fish that occur in the marine environment in the Study Area include the reef community, the unstructured seafloor community, and the surface community (Schwartz 1989). The highest number and diversity of fish typically occur where the habitat is most diverse, including structural complexity (reef systems, continental slopes, deep canyons, currents, temperature), biological productivity (areas of nutrient upwelling), and a variety of physical and chemical conditions (water flow, nutrients, dissolved oxygen, and temperature) (Bergstad et al. 2008; Helfman et al. 2009; Moyle and Cech 1996; Parin 1984; Reshetiloff 2004). Some of the marine fish that occur in the coastal zone migrate between marine and freshwater habitats (Helfman et al. 2009). Other distribution factors, including predator/prey relationships, water quality, and refuge (e.g., physical structure or vegetation cover) operate on more regional or local spatial scales (Reshetiloff 2004). Also, fish may move among habitats throughout their lives based on changing needs during different life stages (Schwartz 1989).

Many habitat and geographic factors impact the distribution of fish within the Study Area—including within range complexes, operating areas (OPAREAs), ports/shipyards, and testing ranges. In the Gulf of Mexico portion of the Study Area, water temperature, seafloor (benthic) habitat, and geographic location appear to be the primary factors (Bowen and Avise 1990), while in the Atlantic Ocean portion, latitudinal changes, temperature, and depth seem to be more important factors influencing species distribution (Gordon 2001; Love and Chase 2007; Macpherson 2002). Each major habitat type in the Study Area (e.g., coral reef, hard bottom, soft bottom, and aquatic beds) supports a fish community associated with it. Also, the number of fish species observed tends to increase with decreasing latitude (transition from north to south) on both sides of the Atlantic; however, this pattern is not as clear for wide-ranging open-ocean species (Macpherson 2002). The specific characteristics of the wide diversity of habitat types within the Study Area are discussed in Section 3.3 (Marine Habitats), Section 3.7 (Marine Vegetation), and Section 3.8 (Marine Invertebrates).

3.9.2.1 Hearing and Vocalization

All fish have two sensory systems to detect sound in the water: the inner ear, which functions very much like the inner ear in other vertebrates, and the lateral line, which consists of a series of receptors along the fish's body (Popper and Schilt 2008). The inner ear generally detects relatively higher-frequency sounds, while the lateral line detects water motion at low frequencies (below a few hundred Hertz [Hz]) (Hastings and Popper 2005).

Many researchers have investigated hearing and vocalizations in fish species (e.g. Astrup 1999; Astrup and Møhl 1993; Casper et al. 2003; Casper and Mann 2006; Coombs and Popper 1979; Dunning et al. 1992; Egner and Mann 2005; Gregory and Clabburn 2003; Hawkins and Johnstone 1978; Higgs et al. 2004; Iversen 1967, 1969; Jørgensen et al. 2005; Kenyon 1996; Mann et al. 2001; Mann et al. 1997; Mann et al. 2005; Meyer et al. 2010; Myrberg 2001; Nestler 2002; Popper 1981; Popper 2008; Popper and Carlson 1998; Popper and Tavolga 1981; Ramcharitar et al. 2001; Ramcharitar and Popper 2004; Ramcharitar et al. 2004; Ramcharitar et al. 2006; Remage-Healey et al. 2006; Ross et al. 1996; Sisneros and Bass 2003; Song et al. 2006; Wright et al. 2005, 2007). Although hearing capability data only exist for fewer than 100 of the 32,000 fish species, current data suggest that most species of fish detect sounds from 50 to 1,000 Hz, with few fish hearing sounds above 4 kHz (Popper 2008). It is believed that most fish have their best hearing sensitivity from 100 – 400 Hz (Popper 2003). Additionally, some clupeids (shad in the subfamily Alosinae) possess ultrasonic hearing (i.e., able to detect sounds above 100,000 Hz) (Astrup 1999).

The inner ears of fish are directly sensitive to acoustic particle motion rather than acoustic pressure (for a more detailed discussion of particle motion versus pressure, see Section 3.0.4 (Acoustic and Explosives Primer). Although a propagating sound wave contains both pressure and particle motion components, particle motion is most significant at low frequencies (less than a few hundred Hertz) and closer to the sound source. However, a fish's gas-filled swim bladder can enhance sound detection by converting acoustic pressure into localized particle motion, which may then be detected by the inner ear. Fish with swim bladders generally have better sensitivity and better high-frequency hearing than fish without swim bladders (Popper and Fay 2010). Some fish also have specialized structures such as small gas bubbles or gas-filled projections that terminate near the inner ear. These fish have been called "hearing specialists," while fish that do not possess specialized structures have been referred to as "generalists" (Popper et al. 2003). In reality many fish species possess a continuum of anatomical specializations that may enhance their sensitivity to pressure (versus particle motion), and thus higher frequencies and lower intensities (Popper and Fay 2010).

Past studies indicated that hearing specializations in marine fish were quite rare (Amoser and Ladich 2005; Popper 2003). However, more recent studies show there are more fish species than originally investigated by researchers, such as deep sea fish, that may have evolved structural adaptations to enhance hearing capabilities (Buran et al. 2005; Deng et al. 2011). Marine fish families Holocentridae (squirrelfish and soldierfish), Pomacentridae (damselfish), Gadidae (cod, hakes, and grenadiers), and Sciaenidae (drums, weakfish, and croakers) have some members that can potentially hear sound up to a few kHz. There is also evidence, based on the structure of the ear and the relationship between the ear and the swim bladder, that at least some deep-sea species, including myctophids, may have hearing specializations and thus be able to hear higher frequencies (Deng et al. 2011; Popper 1977; Popper 1980), although it has not been possible to do actual measures of hearing on these fish from great depths.

Several species of reef fish tested show sensitivity to higher frequencies (i.e., over 1000 Hz). The hearing of the shoulderbar soldierfish (*Myripristis kuntee*) has a high-frequency auditory range extending toward 3 kHz (Coombs and Popper 1979), while other species tested in this family have been demonstrated to lack this high frequency hearing ability (e.g., Hawaiian squirrelfish [*Adioryx xantherythrus*] and saber squirrelfish [*Sargocentron spiniferum*]). Some damselfish can hear frequencies of up to 2 kHz, but with best sensitivity well below 1 kHz (Egner and Mann 2005; Kenyon 1996; Wright et al. 2005, 2007).

Sciaenid research by Ramcharitar et al. (2006) investigated the hearing sensitivity of weakfish (*Cynoscion regalis*). Weakfish were found to detect frequencies up to 2 kHz. The sciaenid with the greatest hearing sensitivity discovered thus far is the silver perch (*Bairdiella chrysoura*), which has responded to sounds up to 4 kHz (Ramcharitar et al. 2004). Other species tested in the family Sciaenidae have been demonstrated to lack this higher frequency sensitivity.

It is possible that the Atlantic cod (*Gadus morhua,* Family: Gadidae) is also able to detect high-frequency sounds (Astrup and Mohl 1993). However, in Astrup and Møhl's (1993) study it is feasible that the cod was detecting the stimulus using touch receptors that were over driven by very intense fish-finding sonar emissions (Astrup 1999; Ladich and Popper 2004). Nevertheless, Astrup and Møhl (1993) indicated that cod have high frequency thresholds of up to 38 kHz at 185 to 200 decibels (dB) relative to (re)

1 micropascal (µPa), which likely only allows for detection of odontocete's clicks at distances no greater than 33 to 98 feet (ft.) (10 to 30 meters [m]) (Astrup 1999).

Experiments on several species of the Clupeidae (i.e., herrings, shads, and menhadens) have obtained responses to frequencies between 40 kHz and 180 kHz (Astrup 1999); however, not all clupeid species tested have demonstrated this very high-frequency hearing. Mann et al. (1998) reported that the American shad can detect sounds from 0.1 to 180 kHz with two regions of best sensitivity: one from 0.2 to 0.8 kHz, and the other from 25 kHz to 150 kHz. This shad species has relatively high thresholds (about 145 dB re 1 µPa), which should enable the fish to detect odontocete clicks at distances up to about 656 ft. (200 m) (Mann et al. 1997). Likewise, other members of the subfamily Alosinae, including alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), and Gulf menhaden (*Brevoortia patronus*), have upper hearing thresholds exceeding 100 to 120 kHz. In contrast, the Clupeidae bay anchovy (*Anchoa mitchilli*), scaled sardine (*Harengula jaguana*), and Spanish sardine (*Sardinella aurita*) did not respond to frequencies over 4 kHz (Gregory and Clabburn 2003; Mann et al. 2001). Mann et al. (2005) found hearing thresholds of 0.1 kHz to 5 kHz for Pacific herring (*Clupyea pallasii*).

Two other groups to consider are the jawless fish (Superclass: Agnatha – lamprey) and the cartilaginous fish (Class: Chondrichthyes – the sharks, rays, and chimeras). While there are some lampreys in the marine environment, virtually nothing is known about their hearing capability. They do have ears, but these are relatively primitive compared to the ears of other vertebrates, and it is unknown whether they can detect sound (Popper and Hoxter 1987). While there have been some studies on the hearing of cartilaginous fish, these have not been extensive. However, available data suggest detection of sounds from 20 to 1,000 Hz, with best sensitivity at lower ranges (Casper et al. 2003; Casper and Mann 2006; Casper and Mann 2009; Myrberg 2001). It is likely that elasmobranchs only detect low-frequency sounds because they lack a swim bladder or other pressure detector.

Most other marine species investigated to date lack higher-frequency hearing (i.e., greater than 1,000 Hz). This notably includes sturgeon species tested to date that could detect sound up to 400 or 500 Hz (Lovell et al. 2005; Meyer et al. 2010) and Atlantic salmon that could detect sound up to about 500 Hz (Hawkins and Johnstone 1978; Kane et al. 2010). Both of these groups of fish have members within the Study Area listed under the ESA.

Bony fish can produce sounds in a number of ways and use them for a number of behavioral functions (Ladich 2008). Over 30 families of fish are known to use vocalizations in aggressive interactions, whereas over 20 families are known to use vocalizations in mating (Ladich 2008). Sound generated by fish as a means of communication is generally below 500 Hz (Slabbekoorn et al. 2010). The air in the swim bladder is vibrated by the sound producing structures (often muscles that are integral to the swim bladder wall) and radiates sound into the water (Zelick et al. 1999). Sprague and Luczkovich (2004) calculated that silver perch can produce drumming sounds ranging from 128 to 135 dB re 1 µPa. Female midshipman fish apparently use the auditory sense to detect and locate vocalizing males during the breeding season (Sisneros and Bass 2003). Sciaenids produce a variety of sounds, including calls produced by males on breeding grounds (Ramcharitar et al. 2001), and a "drumming" call produced during chorusing by reef fish (McCauley and Cato 2000a). Other sounds produced by chorusing reef fish include "popping," "banging," and "trumpet" sounds; altogether, these choruses produce sound levels 35 dB above background levels, at peak frequencies between 250 and 1,200 Hz, and source levels between 144 and 157 dB re 1 µPa (McCauley and Cato 2000a).

3.9.2.2 General Threats

This section covers the existing condition of marine fish as a resource and presents some of the major threats to that resource within the Study Area. Species-specific threats are addressed for each ESA-listed species. Human impacts are widespread throughout the world's oceans, such that very few habitats remain unaffected by human influence (Halpern et al. 2008b). Marine fish with large body sizes and late maturity ages are especially vulnerable to habitat losses and fishing pressure (Reynolds et al. 2005). For example, large sharks account for 60 percent of the marine fish of conservation concern (International Union for Conservation of Nature 2009). The conservation status of only 3 percent of the world's marine fish species has been evaluated, so the threats to the remaining species are unknown at this point (Reynolds et al. 2005).

Overfishing is the most serious threat that has led to the listing of ESA-protected marine species (Crain et al. 2009; Kappel 2005), with habitat loss also contributing to extinction risk (Cheung et al. 2007; Dulvy et al. 2003; Jonsson et al. 1999; Limburg and Waldman 2009; Musick et al. 2000). Approximately 30 percent of the fishery stocks managed by the United States are overfished (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2009). Overfishing occurs when fish are harvested in quantities above a sustainable level. Overfishing impacts both targeted species and nontargeted species (or "bycatch" species) that are often important in marine food webs. Bycatch may also include seabirds, turtles, and marine mammals. In recent decades marine fisheries have targeted species lower on the food web as the abundance of higher-level predators has decreased; some entire marine food webs have collapsed as a result (Crain et al. 2009; Pauly and Palomares 2005). Other factors, such as fisheries-induced evolution and intrinsic vulnerability to overfishing, have been shown to reduce the abundance of some populations (Kuparinen and Merila 2007). Fisheries-induced evolution is a change in genetic composition of the population, such as a reduction in the overall size and individual growth rates resulting from intense fishing pressure. Intrinsic vulnerability describes certain life history traits (e.g., large body size, late maturity age, low growth rate), which increases the susceptibility of a species to overfishing (Cheung et al. 2007).

Another general threat is pollution, which primarily impacts coastal fish near the pollution source. However, global oceanic circulation patterns result in a considerable amount of marine pollutants and debris scattered throughout the open ocean (Crain et al. 2009). Pollutants in the marine environment that may impact marine fish include organic contaminants (e.g., pesticides, herbicides, polycyclic aromatic hydrocarbons, flame retardants, and oil), inorganic chemicals (e.g., heavy metals), and debris (e.g., plastics and waste from dumping at sea) (Pew Oceans Commission 2003). High chemical pollutant levels in marine fish may cause behavioral changes, physiological changes, or genetic damage in some species (Goncalves et al. 2008; Moore 2008; Pew Oceans Commission 2003; van der Oost et al. 2003). Bioaccumulation of metals and organic pollutants is also a concern, particularly in terms of human health, because people consume top predators with potentially high pollutant loads. Bioaccumulation is the net buildup of substances (e.g., chemicals or metals) in an organism directly from contaminated water or sediment through the gills or skin, from ingesting food containing the substance (Newman 1998), or from ingestion of the substance itself (Moore 2008).

The physical presence of trash such as abandoned nets and lines also pose a threat to marine fish. Entanglement in abandoned commercial and recreational fishing gear has caused declines for some marine fish; some species, such as sawfish, are more susceptible to entanglement by marine debris than others (Musick et al. 2000).

The 2010 BP *Deepwater Horizon* oil spill in the Gulf of Mexico was a large-scale event that may have impacted marine fish. More than half of all fish species endemic to the Gulf of Mexico have distribution records that overlap the region of the spill (Chakrabarty et al. 2012). The full impacts of this spill are not yet known and federal agencies, along with academic and independent scientists, continue to monitor and evaluate the fate, transport, and impact of the oil (Lubchenco et al. 2010). The primary groups of fish impacted by the spill were surface-oriented species, nearshore (within 3 nm of the shoreline) species, and species whose spawning season coincided with the spill (National Oceanic and Atmospheric Administration 2010a). Fish can be impacted by the oil directly through the gills, or by consuming oil in *Sargassum* (a type of floating seaweed) or oiled prey. Potentially harmful effects include reduced growth, enlarged livers, heart and respiration rate changes, fin erosion, and reproductive impairment. The most damaging effects of oil on fish populations may be in harming eggs and larvae, because these stages of many fish species are highly sensitive to oil at the surface, in the water column, or on the seafloor, and are subject not only to increased mortality, but also to morphological changes (i.e., deformities) and impaired growth (Greer et al. 2012; Ingvarsdottir et al. 2012; Ocean Conservancy 2010a; Restore the Gulf 2010; Tag A Giant Foundation 2010). In addition, the application of dispersants to the oil spill may have caused a decrease in the production of zooplankton (a food source for fish) and fish on the Alabama Shelf by disrupting the flow of carbon to higher trophic levels (Ortmann et al. 2012).

Atlantic bluefin tuna (*Thunnus thynnus*) eggs and larvae were likely impacted by oil-contaminated waters from the *Deepwater Horizon* spill. Larvae and juvenile deaths could result in population declines for species where larvae and juvenile production is the primary limiting factor. However, less than 10 percent of bluefin tuna spawning habitat was covered by surface oil, and less than 12 percent of larval bluefin tuna was located within contaminated waters in the northern Gulf of Mexico during the 2010 spawning season (Muhling et al. 2012). Federally managed fish species in the Gulf of Mexico that were believed to be impacted by the *Deepwater Horizon* spill at the time of the publication of the National Commission Report (National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling 2011) are listed in Table 3.9-4.

Table 3.9-4: Federally Managed Fish Species Potentially Impacted by the *Deepwater Horizon* Oil Spill

Common Name	Genus/Species	Nature of *Deepwater Horizon* Oil Spill Impact				
		Damage to individual fish or their Essential Fish Habitat	Oil ingestion within *Sargassum* mats	Coastal nursery habitats	Overlap with peak spawning season	Potential impact to Endangered Species Act- listed species
Atlantic Sharpnose Shark	*Rhizoprionodon terraenovae*			✓		
Bigeye Thresher Shark	*Alopias superciliosus*	✓				
Blacktip Shark	*Carcharhinus limbatus*			✓		
Bluefin Tuna	*Thunnus thynnus*				✓	
Blue Marlin	*Makaira nigricans*	✓	✓			
Bull Shark	*Carcharhinus leucas*			✓		
Cobia	*Rachycentron canadum*		✓			
Dolphinfish	*Coryphaena hippurus*		✓			
Gag	*Mycteroperca microlepis*	✓				
Gray Triggerfish	*Balistes capriscus*		✓			
Greater Amberjack	*Seriola dumerili*		✓			
Gulf Sturgeon	*Acipenser oxyrinchus desotoi*					✓
King Mackerel	*Scomberomorus cavalla*	✓				
Longbill Spearfish	*Tetrapturus pfluegeri*	✓	✓			
Longfin Mako Shark	*Isurus paucus*	✓				
Oceanic Whitetip Shark	*Carcharhinus longimanus*	✓				
Red Drum	*Sciaenops ocellatus*			✓		
Red Snapper	*Lutjanus campechanus*			✓		
Sailfish	*Istiophorus platypterus*		✓			
Sandbar Shark	*Carcharhinus plumbeus*	✓				
Scalloped Hammerhead Shark	*Sphyrna lewini*	✓				
Sailfish	*Istiophorus platypterus*	✓				
Shortfin Mako Shark	*Isurus oxyrhinchus*	✓				
Silky Shark	*Carcharhinus falciformis*	✓				
Smalltooth Sawfish	*Pristis pectinata*					✓
Spanish Mackerel	*Scomberomorus maculatus*	✓				
Spinner Shark	*Carcharhinus brevipinna*			✓		
Swordfish	*Xiphias gladius*	✓				
Tiger Shark	*Galeocerdo cuvier*	✓				
Vermilion Snapper	*Rhomboplites aurorubens*			✓		
Whale Shark	*Rhincodon typus*	✓				
White Marlin	*Tetrapturus albidus*	✓	✓			
Yellowfin Tuna	*Thunnus albacares*	✓				

Sources: (Fodrie and Heck 2011; Losada et al. 2010; National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling 2011; National Oceanic and Atmospheric Administration 2010a, b; Restore the Gulf 2010; Tag A Giant Foundation 2010; U.S. Fish and Wildlife Service 2010).

Note: A checkmark indicates a potential impact from the BP *Deepwater Horizon* oil spill on that species.

Other human-caused stressors on marine fish are invasive species, climate change, aquaculture, energy production, vessel movement, and underwater noise:

- Non-native fish pose threats to native fish when they are introduced into an environment lacking natural predators and then compete with, and prey upon, native marine fish for resources (Crain et al. 2009; Whitfield et al. 2007), such as lionfish in the southeastern United States and the Caribbean.
- Global climate change is contributing to a shift in fish distribution from lower to higher latitudes (Brander 2010; Brander 2007; Dufour et al. 2010; Glover and Smith 2003; Limburg and Waldman 2009; Wilson et al. 2010).
- The threats of aquaculture operations on wild fish populations are reduced water quality, competition for food, predation by escaped or released farmed fish, spread of disease, and reduced genetic diversity (Hansen and Windsor 2006; Kappel 2005; Ormerod 2003). The National Oceanic and Atmospheric Administration is developing an aquaculture policy aimed at promoting sustainable marine aquaculture (National Oceanic and Atmospheric Administration 2011).
- Energy production and offshore activities associated with power-generating facilities results in direct and indirect fish injury or mortality from two primary sources, including cooling water withdrawal that results in entrainment mortality of eggs and larvae and impingement mortality of juveniles and adults (U.S. Environmental Protection Agency 2004) and offshore energy development that results in acoustic impacts (Madsen et al. 2006).
- Vessel strikes pose threats to some large, slow-moving fish at the surface, although this is not considered a major threat to most marine fish (Kappel 2005). Sturgeon, particularly Atlantic sturgeon, are vulnerable to ship strikes (Brown and Murphy 2010). Whale sharks (*Rhincodon typus*), basking sharks (*Cetorhinus maximus*), ocean sunfish (*Mola* species), and manta rays (*Manta birostris*) have also been struck by vessels (National Marine Fisheries Service 2010d; Rowat et al. 2007; Stevens 2007; The Hawaii Association for Marine Education and Research Inc. 2005).
- Underwater noise is a threat to marine fish. However, the physiological and behavioral responses of marine fish to underwater noise (Codarin et al. 2009; Popper 2003; Slabbekoorn et al. 2010; Wright et al. 2010) have been investigated for only a limited number of fish species (Popper and Hastings 2009a, b). In addition to vessels, other sources of underwater noise include pile-driving activity (California Department of Transportation 2001; Carlson et al. 2007b; Feist et al. 1992; Mueller-Blenkle et al. 2010; Nedwell et al. 2003; Popper et al. 2006) and seismic activity (Popper and Hastings 2009a). Information on fish hearing is provided in Section 3.9.2.1 (Hearing and Vocalization), with further discussion in Section 3.9.3.1 (Acoustic Stressors).

The discussion above represents general threats to fish. Additional threats to individual species within the Study Area are described in the accounts of those ESA-listed, ESA-proposed, and ESA-candidate species that follow.

3.9.2.3 Atlantic Salmon (*Salmo salar*)

3.9.2.3.1 Status and Management

The Gulf of Maine distinct population segment of Atlantic salmon was listed as federally endangered in 2000 (FR 65 (223): 69459-69462, November 17, 2000). During 2009, the Gulf of Maine distinct population segment was expanded to include Maine's Penobscot, Kennebec, and Androscoggin Rivers, which support remnant wild populations of this species. The Atlantic salmon is managed jointly by NMFS and U.S. Fish and Wildlife Service because it occupies both marine and freshwater habitats. Although Atlantic salmon may occur elsewhere (primarily through stocking programs and aquaculture), only the Gulf of Maine distinct population segment of Atlantic salmon is protected under the ESA. For simplicity in the remainder of this document, "Atlantic salmon" refers to the Gulf of Maine distinct population segment. The species has a fishery management plan, and designated Essential Fish Habitat, managed by the New England Fisheries Management Council, but no landings of this species are allowed because of its endangered status.

In 2009, the National Oceanic and Atmospheric Administration recognized 45 areas as critical habitat for the Atlantic salmon, all in Maine, shown in Figure 3.9-1 (FR 73 (173): 51747-51781, September 5, 2008; FR 74 (152): 39903-39907, August 10, 2009). None of the designated areas are in marine waters beyond estuaries. Critical habitat includes all perennial rivers, streams, estuaries, and lakes connected to the marine environment in the 45 designated critical habitat areas, except those areas specifically excluded by tribal, economic, or military uses. The only critical habitat estuary within the Study Area is the Kennebec River Estuary, which has some military exclusions. Specifically, the contractor-owned shipyard at Bath, Maine, has been excluded from designation for reasons of national security (FR 73 (173): 51747-51781, September 5, 2008; FR 74 (152): 39903-39907, August 10, 2009). The primary constituent elements identified for Atlantic salmon critical habitat include: (1) sites for spawning and incubation, (2) sites for juvenile rearing, and (3) sites for migration. Although successful marine migration is also essential to the conservation of the species, NMFS was not able to identify the essential features of marine migration and feeding habitat. Therefore, marine habitat areas were not designated as critical habitat.

3.9.2.3.2 Habitat and Geographic Range

The Atlantic salmon is anadromous (born in freshwater, migrates into saltwater where it grows and matures, then moves back into freshwater as an adult to spawn). Atlantic salmon may occur in small schools in coastal waters primarily in the top 10 ft. (3 m) of the water column, although they may also occasionally move into deeper water (Hedger et al. 2009). Post-smolts (juveniles leaving freshwater rivers) enter the estuarine portion of the Study Area in the Gulf of Maine, primarily at night, during the late spring when water temperatures exceed 50°F (10°C) (Sheehan et al. 2012).

Labrador Current Large Marine Ecosystem. Atlantic salmon post-smolts move out of the Gulf of Maine along the Scotian Shelf Large Marine Ecosystem, reaching the Newfoundland-Labrador Shelf Large Marine Ecosystem and the Grand Banks by mid-summer (Fay et al. 2006; Saunders et al. 1965), as indicated by tag recoveries (McCormick et al. 1998). For much of their first summer at sea, they remain in the coastal waters of Canada, the Southern Grand Banks (Newfoundland-Labrador Shelf Large Marine Ecosystem), the Labrador Sea, and the northern Gulf of St. Lawrence (Reddin and Short 1991). Decreasing nearshore water temperatures in autumn appear to trigger offshore (greater than 3 nm from shoreline) movements of these fish (Dutil and Coutu 1988). They spend their first winter at sea in the Labrador Sea south of Greenland; then, most travel individually toward Greenland, although some may remain in groups. A small percentage of individuals return to Gulf of Maine coastal rivers after their first winter at sea (Fay et al. 2006).

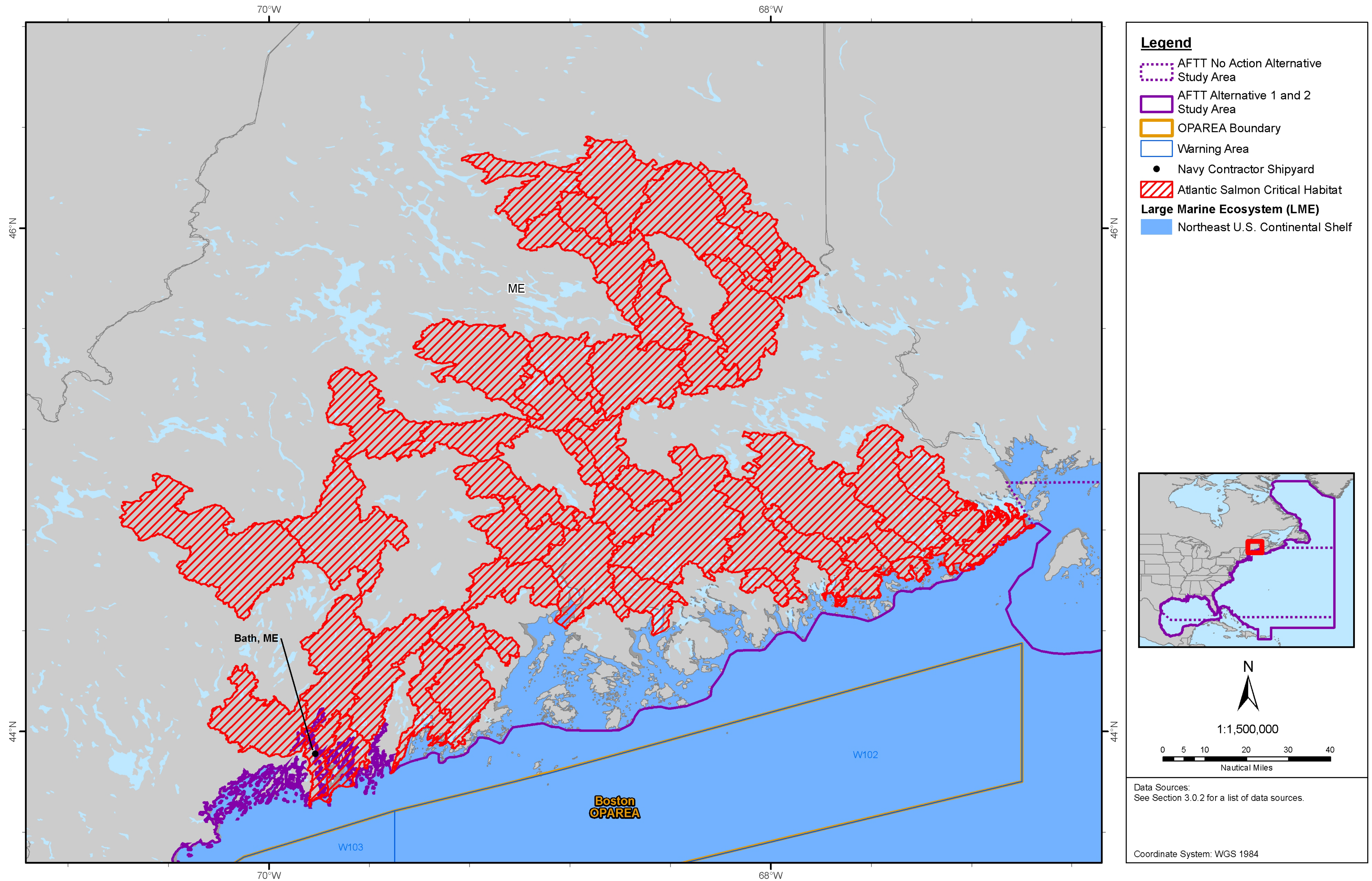

Figure 3.9-1: Critical Habitat Areas for Atlantic Salmon in the Study Area and Adjacent to the Study Area

AFTT: Atlantic Fleet Training and Testing; ME: Maine; OPAREA: Operating Area

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West Greenland Shelf Large Marine Ecosystem. Atlantic salmon migrate great distances in the open ocean to reach feeding areas in the West Greenland Shelf Large Marine Ecosystem and in the Davis Strait between Labrador and Greenland, which is nearly 2,500 miles (mi.) (more than 4,000 km) from their birth rivers (Fay et al. 2006; Reddin and Short 1991; Saunders et al. 1965). North American and European stocks of Atlantic salmon co-occur in these areas while feeding (Fay et al. 2006; Spares et al. 2007). They spend up to 2 years feeding before returning to Gulf of Maine coastal rivers to spawn (Reddin and Short 1991).

Northeast U.S. Continental Shelf Large Marine Ecosystem. The native range of Atlantic salmon in the northwestern Atlantic Ocean is in coastal drainages, from northern Quebec, Canada, to Connecticut. Smolts migrate into marine habitats during approximately 2 weeks each spring, usually during May (McCormick et al. 1998). Spawning adults move into freshwater rivers throughout the spring and summer, with peak movements during June (Fay et al. 2006).

3.9.2.3.3 Population and Abundance

The Gulf of Maine distinct population segment of Atlantic salmon is the last wild population of U.S. Atlantic salmon. Their abundance is low, and either stable or declining. Return rates of smolts to adults from monitored rivers have declined since the mid-to-late 1980s, and indicate low marine survival (Chaput 2012). Estimates of abundance have rarely exceeded 5,000 in any given year since 1967, whereas historical abundances in this same region (excluding the Penobscot River) may have exceeded 100,000 (Fay et al. 2006). Currently, only about 10 percent of the fish in any given river are of natural origin; the rest are escaped aquaculture stocks (Fay et al. 2006; Jonsson et al. 1999; Limburg and Waldman 2009). A conservation hatchery system has slowed the decline and helped stabilize populations at low levels, but it has not increased salmon abundance (FR 74 (117): 29344-29387, June 19, 2009).

3.9.2.3.4 Predator and Prey Interactions

Juvenile salmon feed on a variety of invertebrates in freshwater reaches of coastal rivers for 1 to 3 years before migrating to the ocean (Fay et al. 2006; Jonsson and Jonsson 2004; Lacroix et al. 2004). Mature Atlantic salmon primarily eat fish such as capelin, Atlantic herring, and sand lance (Hansen and Windsor 2006). A variety of organisms feed on Atlantic salmon in both freshwater and marine environments. In coastal waters, Atlantic salmon are particularly vulnerable to predation by seals and cormorants, especially as smolts (Fay et al. 2006; Suuronen and Lehtonen 2012).

3.9.2.3.5 Species-Specific Threats

Incremental increases in marine survival (survival from emigrating smolts to adult return) have a much greater impact on the population than comparable increases in freshwater survival (Legault 2005). However, the factors contributing to low marine survival are not well understood (FR 74 (117): 29344-29387, June 19, 2009). A review of existing studies indicates that mortality during early marine migration varies between 8 and 71 percent with predation being the most common cause in estuaries and river mouths (Thorstad et al. 2012). In recent decades, individuals have grown faster and migrated to sea at a younger age; these smaller smolts are subject to increased mortality at sea (Russell et al. 2012). For stocks feeding in the Norwegian Sea, fluctuations in the phytoplankton community structure may decrease marine survival (Trueman et al. 2012). Sea lice infestation of farmed fish is a major cause of mortality in adult Atlantic salmon (Gargan et al. 2012).

The primary threats impacting the freshwater stages of salmon include restricted fish passage (Baum 1997), degraded water quality and aluminum toxicity (Kroglund et al. 2007), commercial aquaculture (Hansen and Windsor 2006), and reduced spawning habitat (Fay et al. 2006). Increases in freshwater survival could enhance the probability of recovery, but only if marine survival is also improved (FR 74 (117): 29344-29387, June 19, 2009).

3.9.2.4 Largetooth Sawfish (*Pristis pristis*)

The genus *Pristis* includes the smalltooth and largetooth sawfish, both of which are protected under the ESA (Nelson et al. 2004).

3.9.2.4.1 Status and Management

In July 2011, NMFS listed the largetooth sawfish, a type of elasmobranch (shark), as endangered throughout its U.S. range, although the last confirmed record of this species in U.S. waters was from Port Aransas, Texas, in 1961 (FR 76 (133): 40822-40836, July 12, 2011). The largetooth sawfish has undergone severe range reduction in both the northern and southern limits of its former range in the United States (del Monte-Luna et al. 2009; National Marine Fisheries Service 2009a). NMFS determined that there is inadequate management of this species throughout most of its range (FR 74 (144): 37671-37674, July 29, 2009). Until a recovery plan is developed, the smalltooth sawfish recovery plan (National Marine Fisheries Service 2009c) may be used to manage the largetooth sawfish because the species are similar (Seitz and Poulakis 2006). Research has determined that largetooth sawfish recovery may take decades (Simpfendorfer 2000) because of a low rate of population growth. No critical habitat is designated for this species.

3.9.2.4.2 Habitat and Geographic Range

Gulf of Mexico Large Marine Ecosystem. The largetooth sawfish inhabits shallow, subtropical-tropical, estuarine and marine waters in the southwestern portion of the Gulf of Mexico Large Marine Ecosystem, but it is also known from freshwater habitats in large Central American rivers or lake systems outside the Study Area (Wild Earth Guardians 2009). This species moves between freshwater and marine habitats, and some type of dispersal between these systems may be assumed (Thorson 1982).

The largetooth sawfish typically remains close to the bottom of sand or muddy sand, generally in depths less than 35 ft. (11 m) (Charvet-Almeida et al. 2007). The largetooth sawfish can tolerate a range of salinities, moving freely between salinity gradients (FR 74 (144): 37671-37674, July 29, 2009), and is reported in brackish water near river mouths, large embayments, and partially enclosed systems. Largetooth sawfish may occupy deep holes or be found over mud and sand (FR 75 (88): 25174-25184, May 7, 2009). Red mangroves and shallow habitats of varying salinity are important nursery habitats for the largetooth sawfish; these shallow habitats support an abundance of prey (Wild Earth Guardians 2009). The complexity of such habitats also provides juveniles with refuges from larger shark species (FR 74 (144): 37671-37674, July 29, 2009).

3.9.2.4.3 Population and Abundance

The presence of this species in U.S. waters is under review because it has not been documented in the United States in several decades (FR 74 (144): 37671-37674, July 29, 2009). Some largetooth sawfish may rarely and briefly enter U.S. waters along the Texas coast (Wild Earth Guardians 2009). The 2011 decision to list the species as endangered indicates that a U.S. population is presumed to exist, although further research is needed to determine exactly where that population occurs (FR 75 (88): 25174-25184, May 7, 2009).

3.9.2.4.4 Predator and Prey Interactions

The largetooth sawfish uses its saw while foraging, either by stirring up the substrate to expose crustaceans or by stunning and slashing schooling fish (FR 75 (88): 25174-25184, May 7, 2009). Largetooth sawfish (juvenile) have been documented in the stomachs of bottlenose dolphins (Collette and Klein-MacPhee 2002) and bull sharks (Montoya and Thorson 1982).

3.9.2.4.5 Species-Specific Threats

Factors contributing to the decline of the largetooth sawfish include habitat degradation, commercial harvest, gear entanglements, fisheries bycatch, low productivity, and the market for rostral saws (Wild Earth Guardians 2009).

3.9.2.5 Smalltooth Sawfish (*Pristis pectinata*)

The genus *Pristis* includes both the smalltooth sawfish and largetooth sawfish, both of which are protected under the ESA (Nelson et al. 2004).

3.9.2.5.1 Status and Management

The smalltooth sawfish was once common in the Gulf of Mexico and along the east coast of the United States. Today, the severely depleted population is restricted mostly to southern Florida (Poulakis and Seitz 2004; Simpfendorfer 2002; Simpfendorfer and Wiley 2005, 2006). The distinct population segment of smalltooth sawfish in the United States, between Florida and Cape Hatteras, North Carolina, was listed as endangered under the ESA by NMFS in 2003 and by the U.S. Fish and Wildlife Service in 2005; it is co-managed by both agencies (National Marine Fisheries Service 2010b).

In 2009, NMFS designated critical habitat for smalltooth sawfish at two locations; the Charlotte Harbor Estuary and the Ten Thousand Islands portion of the Everglades (FR 74 (169): 45353-45359, September 2, 2009). Most of this designated critical habitat lies in the boundaries of the federally managed Everglades National Park, Rookery Bay Aquatic Preserve, and Cape Romano-Ten Thousand Islands Aquatic Preserve (National Marine Fisheries Service 2009c). The Key West Range Complex does not overlap these critical habitat areas; the northeastern boundary (W-174) of the Key West Range Complex is within approximately 9 nautical miles (nm) of critical habitat at its closest point, as shown in Figure 3.9-2.

The primary constituent elements of smalltooth sawfish critical habitat are designated as red mangroves and shallow habitats characterized by variable salinities with water depths between the mean high water line and 3 ft. (0.9 m) measured at mean lower low water (FR 74 (169): 45353-45359, September 2, 2009).

3.9.2.5.2 Habitat and Geographic Range

The smalltooth sawfish typically inhabits shallow subtropical or tropical estuarine and marine waters. It remains close to the bottom, in deep holes of sand or muddy sand, or over limestone hard bottom, coral reefs, and live bottoms (Poulakis and Seitz 2004). Nursery areas are in shallow nearshore regions and estuaries, especially in mangrove habitat (National Marine Fisheries Service 2010b; Seitz and Poulakis 2006; Simpfendorfer and Wiley 2005). Mangrove prop roots provide refuge from predators, and the sawfish's compressed body allows it to navigate very shallow waters (3 ft. [1 m]) that typically exclude large sharks (National Marine Fisheries Service 2009c). Young-of-the-year sawfish (less than 39 inches [in.] or 100 centimeters [cm]) have been observed swimming in only a few inches of water (National Marine Fisheries Service 2009c). Juvenile smalltooth sawfish exhibit a high site fidelity to nearshore areas, often residing in one area between 15 and 55 days (Simpfendorfer 2006). Larger individuals may occur down to 400 ft. (120 m) (Poulakis and Seitz 2004; Simpfendorfer 2006), although tagging studies indicate that adults spend more time in shallow water than previously suspected, and are only occasionally found in deeper waters (Simpfendorfer and Wiley 2005). The smalltooth sawfish may also be associated with sea fans, artificial reefs, and offshore drilling platforms (Poulakis and Seitz 2004).

Southeast U.S. Continental Shelf Large Marine Ecosystem. The smalltooth sawfish occurs in large rivers and estuaries (e.g., St. Johns River) in the Southeast U.S. Continental Shelf Large Marine Ecosystem in the Study Area, but its present geographic range in this ecosystem is primarily limited to southern Florida. Historic records indicate that this species may have made seasonal migrations northward along the Atlantic coast during summer (Simpfendorfer et al. 2008). However, because encounters north of Florida are infrequent, the species is believed to no longer migrate (Simpfendorfer and Wiley 2006).

Gulf of Mexico Large Marine Ecosystem. The smalltooth sawfish also occurs in large rivers and estuaries in the Gulf of Mexico Large Marine Ecosystem in the Study Area (e.g., Mississippi River), particularly at river mouths FR 74 (169): 45353-45359, September 2, 2009 (National Marine Fisheries Service 2009c; Simpfendorfer 2002).

3.9.2.5.3 Population and Abundance

No estimates of the size of the smalltooth sawfish population are available. The best available data suggest that the current population is a small fraction of its historical size (National Marine Fisheries Service 2010b; Simpfendorfer 2006). Limited scientific survey data are available for this species, but dockside surveys of recreational anglers in Everglades National Park, beginning in 1972, suggest that the population there has at least stabilized, and may be increasing. Between 1989 and 2004, the population increased by approximately 5 percent per year (Carlson et al. 2007a).

3.9.2.5.4 Predator and Prey Interactions

The smalltooth sawfish feeds primarily at night (National Marine Fisheries Service 2009c) and uses its saw while feeding to stir the substrate to expose crustaceans or to stun and slash schooling fish (FR 74 (169): 45353-45359, September 2, 2009). Smalltooth sawfish, particularly juveniles, are preyed upon by bull sharks and other sharks occurring in shallow coastal waters.

3.9.2.5.5 Species-Specific Threats

Factors contributing to the decline of the smalltooth sawfish are the same as for the largetooth sawfish (Section 3.9.2.4.5, Species-Specific Threats): habitat degradation, commercial harvest, gear entanglements, fisheries bycatch, low productivity, and the market for rostral saws (Wild Earth Guardians 2009). Sawfish are easily entangled in abandoned or derelict fishing gear and other plastic debris is an ongoing major threat to the species (National Marine Fisheries Service 2009c). Incidental take as bycatch in various fisheries (especially gill nets) has also contributed to their decline (Musick et al. 2000). People continue to kill smalltooth sawfish by removing the rostral saw or shooting them with firearms (Seitz and Poulakis 2006).

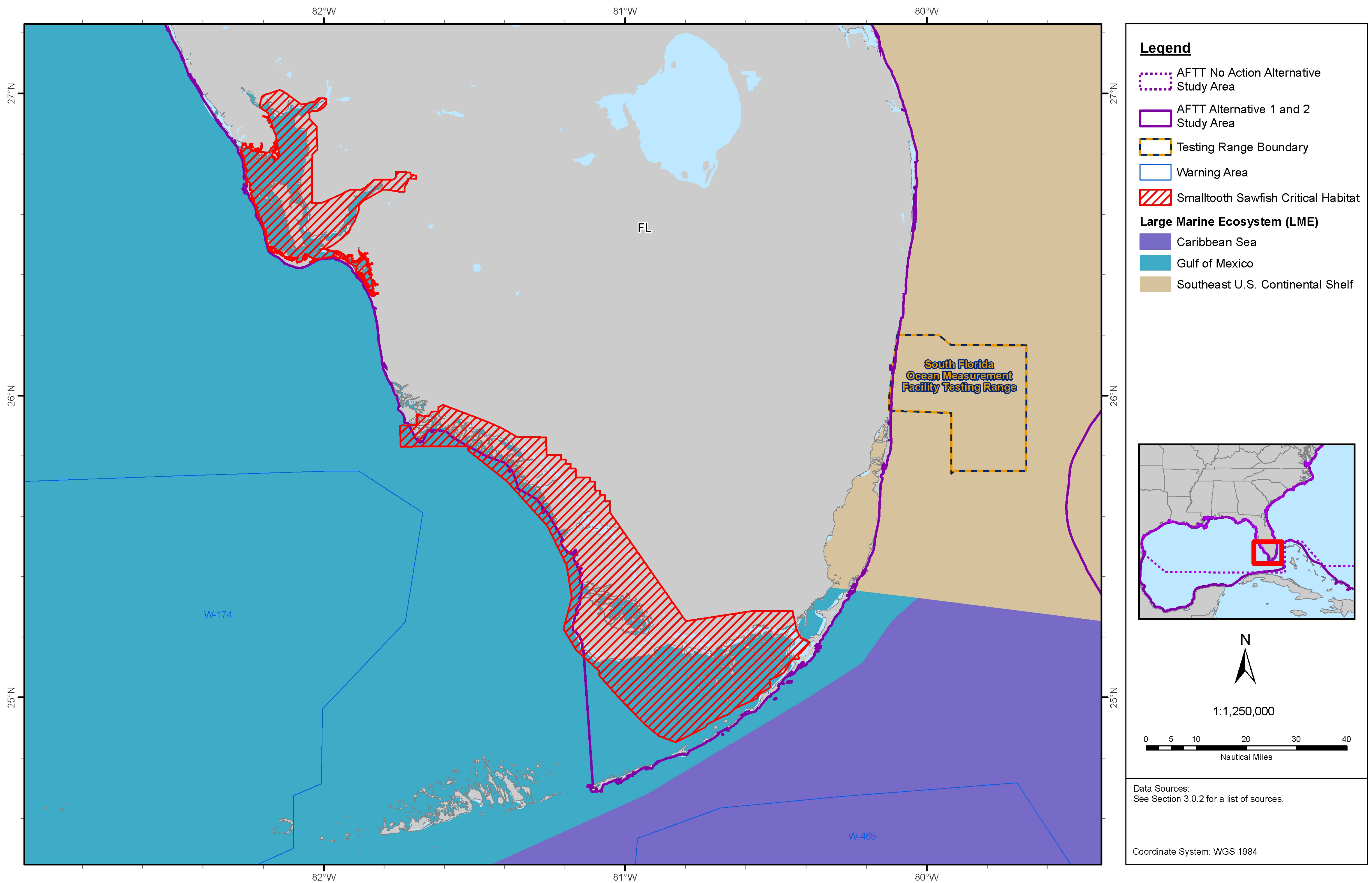

Figure 3.9-2: Critical Habitat Areas for Smalltooth Sawfish in the Study Area and Adjacent to the Study Area
AFTT: Atlantic Fleet Training and Testing; FL: Florida

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3.9.2.6 Shortnose Sturgeon (*Acipenser brevirostrum*)

3.9.2.6.1 Status and Management

In 1967, the shortnose sturgeon was listed as endangered under the Endangered Species Preservation Act of 1966, which predated the ESA; this species remains on the list as endangered throughout its range along the Atlantic coast (National Marine Fisheries Service 1998). No critical habitat is designated for this species.

NMFS manages 19 distinct population segments of the anadromous shortnose sturgeon (National Marine Fisheries Service 1998); those occurring in rivers and estuaries of the Study Area are listed below:

- Kennebec River System (including the Sheepscot, Kennebec, and Androscoggin Rivers), Maine
- Hudson River, New York
- Delaware River, Delaware, New Jersey, New York, and Pennsylvania
- Chesapeake Bay and Potomac River, Maryland and Virginia
- St. Marys River, Georgia
- St. Johns River, Florida

3.9.2.6.2 Habitat and Geographic Range

After hatching in upstream reaches of rivers, shortnose sturgeon larvae orient into the river current and away from light sources, generally staying near the bottom and seeking cover. By two weeks of age, the larvae emerge from cover and swim in the water column, moving downstream from the spawning site. By two months, juvenile behavior becomes similar to adults, with active swimming in a wide range of thermal conditions (Deslauriers and Kieffer 2012) and foraging at night along the bottom (Richmond and Kynard 1995).

The shortnose sturgeon primarily occurs in freshwater rivers and coastal estuaries of the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems, occasionally moving short distances to the mouths of estuaries and into the nearshore coastal waters (Dadswell 2006; National Marine Fisheries Service 1998). In estuarine systems, juveniles and adults occupy areas with little or no current over a bottom composed primarily of mud and sand (Secor et al. 2000). Adults are found in deep water (35–100 ft. [10 –30 m]) in winter and in shallow water (7–35 ft. [2–10 m]) during summer (Welsh et al. 2002). Individual shortnose sturgeon do not disperse far along the coastline beyond their home river estuaries (National Marine Fisheries Service 1998). Based on this information, the shortnose sturgeon is not expected to occur in the open-ocean portion of the Study Area, and its potential occurrence in the Study Area is concentrated within the bays and estuaries associated with each distinct population segment.

3.9.2.6.3 Population and Abundance

Certain subpopulations of the shortnose sturgeon have increased substantially in recent years, particularly in the Hudson River (Bain 1997; Stein et al. 2004). Several strong cohorts had higher than expected survival during the 1980s and 1990s, then recovery slowed during the late 1990s (Woodland and Secor 2007). Abundances in the Hudson River population exceed recovery criteria (Bain et al. 2007; Woodland and Secor 2007). The Delaware River supports a well-documented population (8,445 individuals) (Welsh et al. 2002), but the abundance of the Chesapeake Bay and Potomac River population is not known.

3.9.2.6.4 Predator and Prey Interactions

Feeding patterns of the shortnose sturgeon vary seasonally between northern and southern river systems. In northern rivers, some sturgeon feed in freshwater during summer and over sand-mud bottoms in the lower estuary during fall, winter, and spring (National Marine Fisheries Service 1998). In contrast, in southern rivers, feeding has been observed during winter at or just downstream of where saltwater and freshwater meet (Kynard 1997). Shortnose sturgeon in the Southeast U.S. Continental Shelf Large Marine Ecosystem reduce their feeding activity during summer months (National Marine Fisheries Service 1998; Sulak and Randall 2002).

The shortnose sturgeon feeds by suctioning polychaetes (marine worms), crustaceans, molluscs, and small fish from the bottom (National Marine Fisheries Service 1998; Stein et al. 2004). Young-of-the-year sturgeon (individuals less than one year old) have been found in the stomachs of yellow perch (National Marine Fisheries Service 1998); predation on older sturgeon is not well-documented, although sharks likely prey on them in the marine environment (National Marine Fisheries Service 1998).

3.9.2.6.5 Species-Specific Threats

Principal causes of the shortnose sturgeon's decline include pollution, overharvesting in commercial fisheries (including bycatch in the shad fishery), and its resemblance to the formerly commercially valuable Atlantic sturgeon (Bain et al. 2007; National Marine Fisheries Service 1998). Other risk factors include poaching (northern rivers); accidental introduction of exotic species; very low productivity; freshwater spawning and nursery areas destroyed or degraded because of human-caused dissolved oxygen reductions; contaminants (e.g., heavy metals, pesticides, and organochlorine compounds); siltation from dredging, bridge construction, and demolition; impingement on power plant cooling water intake screens; impoundment operations; and hydraulic dredging operations (Collins et al. 2000; National Marine Fisheries Service 1998).

3.9.2.7 Gulf Sturgeon (*Acipenser oxyrinchus desotoi*)

The Gulf sturgeon and the Atlantic sturgeon are members of the same species but do not overlap geographically. The ESA-listed Atlantic sturgeon is discussed in Section 3.9.2.8 (Atlantic Sturgeon [*Acipenser oxyrinchus oxyrinchus*]).

3.9.2.7.1 Status and Management

The Gulf sturgeon was federally listed in 1991 as threatened throughout its entire range in the Gulf of Mexico Large Marine Ecosystem (Florida, Alabama, Louisiana, and Mississippi) and is managed by both NMFS and U.S. Fish and Wildlife Service. All U.S. fisheries for the species have been closed since its listing. A recovery plan published for the Gulf sturgeon in 1995 reported that, bycatch along the gulf coast was a major source of mortality (U.S. Fish and Wildlife Service and Gulf States Marine Fisheries Commission 1995). Management efforts to reduce this bycatch include requiring gear modifications in nearshore trawl fisheries (Smith and Clugston 1997). In a five-year review published in 2009, NMFS and U.S. Fish and Wildlife Service concluded that the Gulf sturgeon was stable, indicating that 26 to 50 percent of recovery objectives have been achieved (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2009).

In 2003, NMFS designated critical habitat for Gulf sturgeon. Primary constituent elements that were identified for the conservation of the Gulf sturgeon include the following:

- Abundant food items, such as detritus, aquatic insects, worms, or molluscs, within riverine habitats for larval and juvenile life stages; and abundant prey items, such as amphipods, lancelets, polychaetes, gastropods, ghost shrimp, isopods, molluscs or crustaceans, within estuarine and marine habitats, and substrates for subadult and adult life stages.
- Riverine spawning sites with substrates suitable for egg deposition and development, such as limestone outcrops and cut limestone banks, bedrock, large gravel or cobble beds, marl, soapstone, or hard clay.
- Riverine aggregation areas, also referred to as resting, holding, and staging areas, used by adults, subadults, or juveniles, generally, but not always, located in holes below normal riverbed depths, believed necessary for minimizing energy expenditures during freshwater residency and possibly for osmoregulatory functions.
- A flow regime (i.e., the magnitude, frequency, duration, seasonality, and rate-of-change of freshwater discharge over time) necessary for normal behavior, growth, and survival of all life stages in the riverine environment, including migration, breeding site selection, courtship, egg fertilization, resting, and staging, and for maintaining spawning sites in suitable condition for egg attachment, egg sheltering, resting, and larval staging.
- Water quality, including temperature, salinity, pH, hardness, turbidity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages.
- Sediment quality, including texture and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages.
- Safe and unobstructed migratory pathways necessary for passage within and between riverine, estuarine, and marine habitats (e.g., an unobstructed river or a dammed river that still allows for passage).

Most of these primary constituent elements are not applicable to the marine portions of the Study Area. Only the Panama City OPAREA overlaps with Gulf sturgeon critical habitat (Figure 3.9-3). This critical habitat (Unit 11) encompasses Florida nearshore Gulf of Mexico waters in Escambia, Santa Rosa, Okaloosa, Walton, Bay, and Gulf counties in Florida. Unit 11 is important because it provides migration habitat for Gulf sturgeon *en route* from Gulf of Mexico winter and feeding grounds to their spring and summer natal (hatching) rivers (the Yellow, Choctawhatchee, and Apalachicola Rivers). Gulf sturgeon remain within 1 mi. (1.6 km) of the coastline between Pensacola Bay and Apalachicola Bay, in depths of less than 20 ft. (6 m) during the winter (Fox et al. 2000; Fox et al. 2002; U.S. Fish and Wildlife Service 2009).

3.9.2.7.2 Habitat and Geographic Range

Gulf of Mexico Large Marine Ecosystem. The anadromous Gulf sturgeon occurs only in the Gulf of Mexico Large Marine Ecosystem in rivers, bays, and estuaries from Florida to Louisiana (National Marine Fisheries Service 2010a). Telemetry studies suggest that the Gulf sturgeon occurs in nearshore marine waters from about October to February (Robydek and Nunley 2012); its distribution is likely influenced by the availability of preferred prey (Ross et al. 2009), particularly within the Suwannee River estuary and vicinity (Harris et al. 2005). Young-of-the-year use rivers as nursery areas, especially sandbars and sand shoals in shallow areas (Carr and Carr 1996). Juveniles also prefer habitats consisting of sand or vegetated areas (Wakeford 2001). While juveniles can tolerate high salinities for extended durations, they appear to make only infrequent use of estuarine waters (Sulak et al. 2009). Inshore areas are likely important nursery habitats for younger fish (Ross et al. 2009).

Adult Gulf sturgeon leave the Study Area and return to the freshwater reaches of their natal rivers to spawn (Edwards et al. 2003; Heise et al. 2004; Rogillio et al. 2007). They migrate in spring from the estuarine and marine waters of the northern Gulf of Mexico to riverine habitat (including the Suwannee River, other major Florida rivers [e.g., Apalachicola, Escambia, and Choctawhatchee Rivers], and the Pascagoula River drainage system [Mississippi]) as water temperatures begin to warm from 64°F to 72°F (18°C to 22°C) (Chapman and Carr 1995; Craft et al. 2001; Fox et al. 2000; Wooley and Crateau 1985). Gulf sturgeon may also spawn during autumn in some river systems, such as the Suwannee (Randall and Sulak 2012). They migrate downstream when waters once again cool (September to November); by December, all except the young-of-the-year Gulf sturgeon have returned to the Gulf of Mexico (Carr and Carr 1996; Foster and Clugston 1997; Smith and Clugston 1997). Some studies in the Mississippi Sound have reported a fall migration into marine waters during October and November (Heise et al. 2004; Rogillio et al. 2007; Ross et al. 2009).

Once Gulf sturgeon leave freshwater rivers, they are typically found within 1,000 m (3,280 ft.) of the shoreline (Robydek and Nunley 2012) and they often remain in estuaries and nearshore bays in water less than 35 ft. (10 m) deep (Ross et al. 2009). Coastal foraging grounds include barrier island inlets with strong tidal currents and estuaries less than 7 ft. (2 m) deep with clean sand substrate (Fox et al. 2002; Harris et al. 2005; Ross et al. 2009). Some individuals, particularly females between spawning years (Fox et al. 2002; Ross et al. 2009), move into deeper offshore waters for short periods during cold weather (Sulak et al. 2009). No tagged individuals have been detected in offshore waters deeper than 33 ft. (10 m). However, some individuals may move offshore without being detected (Ross et al. 2009).

Tagging data from December 2003 to April 2004 indicate that Gulf sturgeon spent the winter near beaches of northwestern Florida. Two individuals were tracked moving along the coast southeast of the mouth of St. Andrew Bay (U.S. Fish and Wildlife Service 2004). Relocation data from December 2005 to April 2006 indicate Gulf sturgeon movements northeast of the mouth of St. Andrew Bay. Relocated fish occurred in water depths ranging from 12 to 40 ft. (4 to 12 m) and from 0.5 to 2 mi. (from 0.8 to 3.2 km) offshore (U.S. Fish and Wildlife Service 2006). Researchers suspected that the relocated fish were feeding on prey associated with fine sand and shell hash substrates (U.S. Fish and Wildlife Service 2006).

3.9.2.7.3 Population and Abundance

Overall, Gulf sturgeon populations are either stable or are slowly increasing, with seven river systems containing reproducing populations; the Suwannee River in particular seems to be recovering well (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2009). Population size in the Escambia River system may have declined following a hurricane. Population estimates in the western end of the Gulf sturgeon's range—such as the Pearl and Pascagoula Rivers—are lacking because research has been limited in those systems since hurricanes Ivan (2004) and Katrina (2005) (Rogillio et al. 2007).

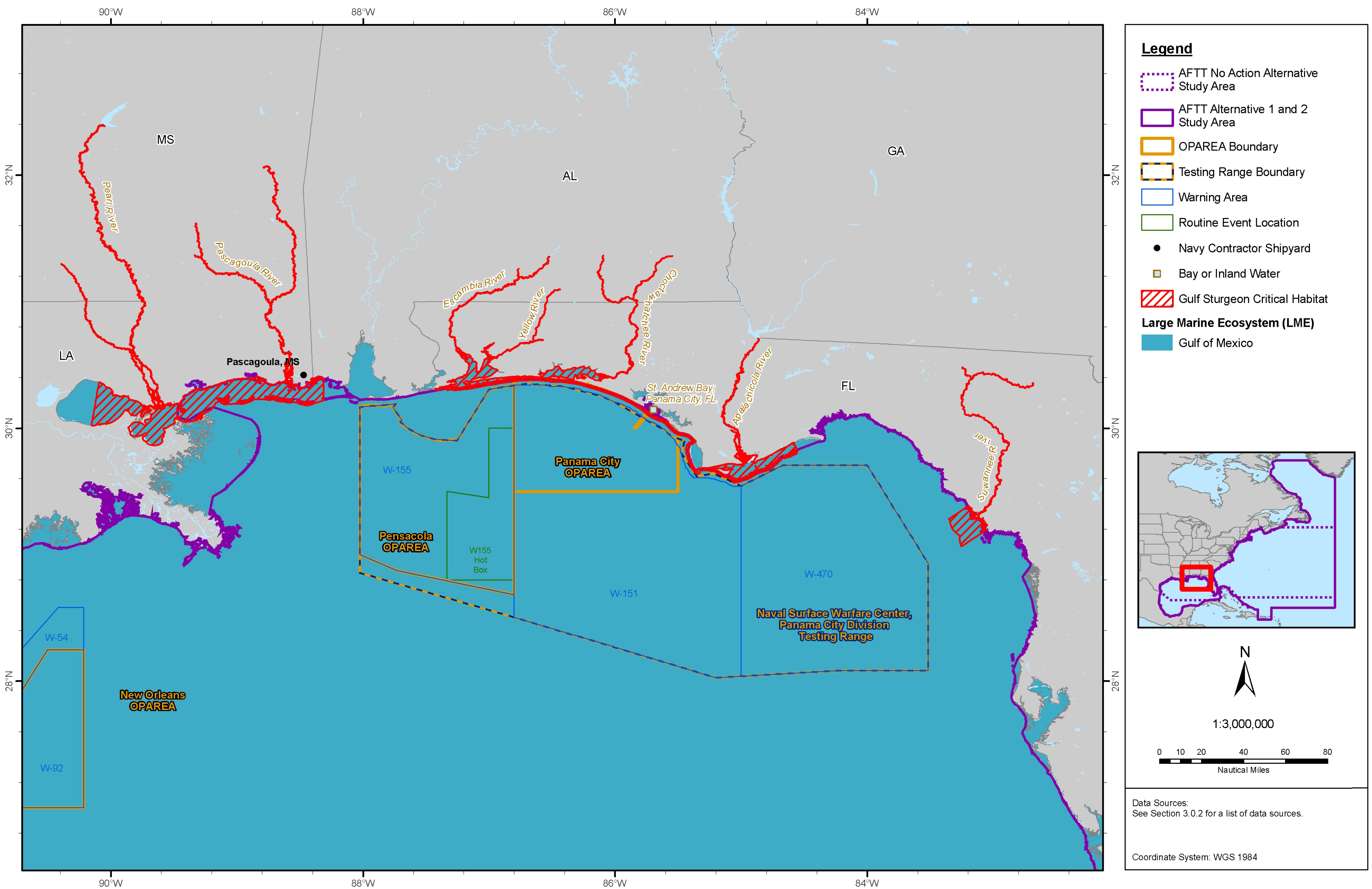

Figure 3.9-3: Critical Habitat Areas for Gulf Sturgeon in and Adjacent to the Study Area

AFTT: Atlantic Fleet Training and Testing; AL: Alabama; FL: Florida; GA: Georgia; LA: Louisiana; MS: Mississippi; OPAREA: Operating Area

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3.9.2.7.4 Predator and Prey Interactions

Feeding habits vary depending on life stage, but in general the Gulf sturgeon is considered an opportunistic feeder (feeding on whatever food is available). Subadults and adults typically do not feed while in freshwater, and may lose from 12 to 30 percent of their body weight during their freshwater stay. However, Sulak et al. (2012) presented evidence of feeding in freshwater systems (Suwannee River) using carbon isotopes. In estuarine and marine habitats, they eat a wide range of invertebrates associated with the bottom, including amphipods, lancelets, polychaetes, gastropods, shrimp, crabs, isopods, molluscs, and crustaceans (U.S. Fish and Wildlife Service and Gulf States Marine Fisheries Commission 1995; U.S. Fish and Wildlife Service and National Marine Fisheries Service 2009). Sand dollars and annelids may also be preyed upon during winter off the barrier islands of Mississippi Sound (Ross et al. 2009). Off the Suwannee River, adults primarily feed on brachiopods, brittle stars, amphipods, and ghost shrimp (Carr et al. 1996; Harris et al. 2005).

Sharks likely prey on all species of sturgeon while they are in the marine environment (National Marine Fisheries Service 1998).

3.9.2.7.5 Species-Specific Threats

Overfishing, habitat loss, and degradation have contributed to the current status of this subspecies. Habitat threats include damming of major rivers (e.g., Pearl, Alabama, and Apalachicola) that prevents upstream spawning, dredged material disposal, channel maintenance, oil and gas exploration, shrimp trawling, and water quality degradation (pesticides, heavy metals, and other agricultural and industrial contaminants) (Smith and Clugston 1997; U.S. Fish and Wildlife Service and Gulf States Marine Fisheries Commission 1995; U.S. Fish and Wildlife Service and National Marine Fisheries Service 2009). Other threats include potential hybridization with nonnative sturgeon from aquaculture farms and diseases spread by farmed sturgeon (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2009).

3.9.2.8 Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*)

The Atlantic and Gulf sturgeon are conspecific subspecies (members of the same species). The two fish have similar reproductive and feeding life history but do not overlap geographically. The Atlantic sturgeon is described below.

3.9.2.8.1 Status and Management

NMFS was petitioned to list the Atlantic sturgeon under the ESA in 2009. In 2010, NMFS found that the petition presented substantial scientific or commercial information indicating that listing may be warranted (FR 75 (3): 838-841, January 6, 2010). After completing an ESA status review of the Atlantic sturgeon, NMFS issued two final rules on 6 February 2012—one for the Southeast Region, listing the Carolina and South Atlantic distinct population segments as endangered (FR 77 (24): 5914-5982, February 6, 2012); the other for the Northeast Region, listing the Gulf of Maine distinct population segment as threatened and the Chesapeake and New York Bight distinct population segments as endangered (FR 77 (24): 5880-5912, February 6, 2012).

The Atlantic sturgeon is also managed under a fishery management plan implemented by the Atlantic States Marine Fisheries Commission, but a coast-wide moratorium on its harvest is in effect (Greene et al. 2009). NMFS augmented the Atlantic States Marine Fisheries Commission moratorium with a similar moratorium for federal waters. Amendment 1 to Atlantic States Marine Fisheries Commission's Atlantic Sturgeon Fishery Management Plan also includes measures for preservation of existing habitat, habitat restoration and improvement, monitoring of bycatch and stock recovery, and breeding and stocking protocols (FR 75 (3): 838-841, January 6, 2010).

3.9.2.8.2 Habitat and Geographic Range

As an anadromous fish, mature Atlantic sturgeon undergo seasonal migrations between freshwater habitats, where they spawn, and marine waters, where they forage and grow. During nonspawning years, adults remain in marine waters either year-round or seasonally (Bain 1997). Spawning adults migrate upriver in spring, beginning in February in the south, April in the mid-Atlantic, and May in Canadian waters (Dadswell 2006). After spawning in freshwater in the spring and early summer, adults migrate back into estuarine and marine waters. Tagging data indicate that immature Atlantic sturgeon disperse widely once they move into coastal waters (Secor et al. 2000). Dispersal is extensive: north and south along the Atlantic coast and seaward to the edge of the continental shelf (Bain 1997).

In the United States, Atlantic sturgeon can occur as far north as the St. Croix River in Maine, and as far south as the St. Johns River in Florida. Atlantic sturgeon juveniles in the Northeast U.S. Continental Shelf and Scotian Shelf Large Marine Ecosystems may occur in salinities ranging from 5 to 25 parts per thousand in estuaries, usually over a mud-sand bottom (Dadswell 2006). Subadults and adults live in coastal waters and estuaries when not spawning, generally in shallow (35–165 ft. [10–50 m]) inshore areas of the continental shelf where they feed (FR 75 (3): 838-841, January 6, 2010). In a 2004 study using fisheries bycatch data, Atlantic sturgeon were found to be strongly associated with specific coastal areas, such as the mouths of Narragansett Bay and Chesapeake Bay and the inlets of the North Carolina Outer Banks; most fish were caught within a narrow range of depths (30–160 ft. [10–50 m]) over gravel and sand, and to lesser extent, silt and clay (Stein et al. 2004).

3.9.2.8.3 Population and Abundance

Between 7 and 10 genetically distinct populations along the U.S. Atlantic coast can be statistically differentiated (Stein et al. 2004). Abundance estimates are available for only two of these populations — the Hudson River (New York) (9,500 juveniles) and the Altamaha River (Georgia) (2,000 subadults)— although these data are from 1995 (National Marine Fisheries Service 2009a). The mean annual spawning stock size has been estimated at 870 individuals, although about half of the Hudson River population may be of hatchery origin (National Marine Fisheries Service 2007). The Altamaha River supports one of the healthiest Atlantic sturgeon populations in the southeast, which appears to be stable (Peterson et al. 2008). The status of the other Atlantic sturgeon populations varies widely, from the large but possibly declining Hudson River population, to small groups of survivors of a once robust population that has undergone considerable decline (Delaware River), to apparently locally extinct (Maryland tributaries of Chesapeake Bay and St. Johns River, Florida) (National Marine Fisheries Service 2007; Waldman and Wirgin 1998).

3.9.2.8.4 Predator and Prey Interactions

Like all sturgeon, the Atlantic sturgeon feeds along the bottom on invertebrates such as isopods, crustaceans, worms, and molluscs (National Marine Fisheries Service 2010c). It has also been documented to feed on fish (Bain 1997). Evidence of predation on sturgeon is scarce, but some researchers believe they are taken by the American alligator (*Alligator mississippiensis*), alligator gar (*Atractosteus spatula*), and striped bass (*Morone saxatilis*) (Dadswell 2006). Sharks likely prey on all species of sturgeon in the marine environment (National Marine Fisheries Service 1998).

3.9.2.8.5 Species-Specific Threats

Historical overfishing resulted in declines in Atlantic sturgeon abundance. Atlantic sturgeon bycatch is the most substantial threat in the ocean environment (National Marine Fisheries Service 2009a). Other threats include the marine parasitic copepod (*Dichelesthium oblongum*), which has been observed on up to 93 percent of the sturgeon sampled in the New York Bight during 2007 to 2008. Substantially higher parasite burdens, stress, and reduced physiological condition associated with Atlantic sturgeon in areas of sewage contamination may have negative impacts on juvenile Atlantic sturgeon (Fast et al. 2009). Vessel strikes (Brown and Murphy 2010) and degraded water quality (Collins et al. 2000) have also been noted as threats to this species.

3.9.2.9 Cusk (*Brosme brosme*)

3.9.2.9.1 Status and Management

The cusk was designated as a candidate species under the ESA in 2007, largely based on survey data indicating a declining trend in abundance (O'Brien 2006). Since the 1960s, cusk landings have declined by approximately 90 percent, and the mean length of cusk has decreased from 25.2 in. (64 cm) to 19.7 in. (50 cm) (O'Brien 2006). However, because the status review for this species is still underway, no conservation or management plans are in place for cusk in the United States (National Marine Fisheries Service 2009b).

3.9.2.9.2 Habitat and Geographic Range

The cusk is limited geographically by its need for cold water; it ranges only as far south as the Northeast U.S. Continental Shelf Large Marine Ecosystem around New Jersey (National Marine Fisheries Service 2009b). The cusk also occurs around the Scotian Shelf Large Marine Ecosystem (National Marine Fisheries Service 2009b), the Strait of Belle Isle and on the Grand Banks of Newfoundland in the Newfoundland-Labrador Shelf Large Marine Ecosystem (National Marine Fisheries Service 2009b), and infrequently at the southern tip of Greenland in the Labrador Current Open Ocean Area (National Marine Fisheries Service 2009b).

Cusk inhabit small shoals on rock, pebble, and gravel bottoms at depths between 60 and 1,805 ft. (20 and 550 m) (Collette and Klein-MacPhee 2002) and temperatures ranging from 32°F to 50°F (0°C to 10°C) (National Marine Fisheries Service 2009b). Cusk eggs are buoyant; after hatching, larvae remain near the surface, then settle to the bottom as 2 in. (5 cm) juveniles (Fisheries and Oceans Canada 2004). Adult cusk are solitary and remain in offshore waters; they are rarely captured in waters less than 65 to 100 ft. (20 to 30 m) deep (Knutsen et al. 2009). Unlike other cods, cusk rarely leave the seafloor, and do not disperse very far once settled into a particular habitat area (Collette and Klein-MacPhee 2002).

3.9.2.9.3 Population and Abundance

Fisheries data indicate substantial decreases in biomass and abundance of cusk, most likely because of fishery harvest; U.S. landings dropped from approximately 4,200 tons (3,800 metric tons) in the early 1980s to 87 tons (79 metric tons) in 2004 (Collette and Klein-MacPhee 2002; National Marine Fisheries Service 2009b). Very little fisheries-independent data exists for this species.

3.9.2.9.4 Predator and Prey Interactions

The cusk feeds primarily on crustaceans and shellfish, fish (including flatfish and gurnard), and occasionally on sea stars. However, little information is available on its diet because most cusk have emptied their stomach contents by the time they reach the surface, making stomach-content analysis very difficult (Fisheries and Oceans Canada 2004). The primary food composition (by percent weight) is crustaceans (51 percent), fishes (16 percent), and echinoderms (15 percent), with some variation by region (Collette and Klein-MacPhee 2002). The most frequent predator of cusk are spiny dogfish (*Squalus acanthias*), but other fish (cods, hakes, skates, and flounders) and marine mammals (hooded seal [*Cystophora cristata*] and gray seal [*Halichoerus grypus*]) also feed on cusk (Collette and Klein-MacPhee 2002).

3.9.2.9.5 Species-Specific Threats

Threats to cusk are poorly understood. Bycatch of cusk by commercial fisheries targeting cod and haddock is likely the primary cause of decline in both the United States and Canada (Fisheries and Oceans Canada 2004; National Marine Fisheries Service 2009b). Canada established a bycatch limit of 1,000 tons of cusk in 1999, and reduced the limit to 750 tons of cusk in 2003 (Crozier et al. 2004). Deepwater seismic testing within cusk habitat by the oil and gas industry could impact fish closely associated with the seafloor (Fisheries and Oceans Canada 2011).

3.9.2.10 American Eel (*Anguilla rostrata*)

3.9.2.10.1 Status and Management

American eel are currently under petition as a candidate for listing under the ESA by the U.S. Fish and Wildlife Service because they have undergone substantial declines throughout their range (FR 76 (189): 60431-60444, September 29, 2011). Determining status trends is challenging because the available data are limited to a few locations that may not represent the entire range for this species (Wirth and Bernatchez 2003). In 2007, NMFS and the U.S. Fish and Wildlife Service determined that the American eel population appeared stable for the long term and listing was not warranted (72 FR 4967). However, new information in the 2011 petition prompted the U.S. Fish and Wildlife Service to begin a new status review. The Atlantic States Marine Fisheries Commission has had a fishery management plan for the American eel since 1999 (Atlantic States Marine Fisheries Commission 2000).

3.9.2.10.2 Habitat and Geographic Range

The American eel ranges throughout all large marine ecosystems in the Study Area, from Greenland south along the Atlantic Coast and into the Caribbean (U.S. Fish and Wildlife Service 2011). The American eel is catadromous, meaning it is born in saltwater and migrates into freshwater to mature (Jessop et al. 2002), although evidence suggests that some populations never migrate into fresh water and inhabit only estuarine and brackish water (Arai and Chino 2012).

North Atlantic Subtropical Gyre. Spawning of the U.S. population of American eel is believed to occur in the Sargasso Sea of the Atlantic Ocean. From there, eggs, larvae, and juveniles are dispersed largely via the Gulf Stream and other oceanic currents as they feed at the surface of the ocean. As juveniles, or “glass eels,” they enter coastal waters where they further mature into ‘‘elvers’’ and then a late juvenile stage known as ‘‘yellow eels” (U.S. Fish and Wildlife Service 2011). Older juveniles and adults occupy estuarine and freshwater habitats, often swimming far upriver into lakes, ponds, and headwater streams, where they may spend up to 30 years as adults. Mature adults, or “silver eels,” migrate to the Sargasso Sea to spawn and die (U.S. Fish and Wildlife Service 2011).

3.9.2.10.3 Population and Abundance

The American eel exists as a single population that disperses widely from its spawning grounds in the Sargasso Sea, making abundance difficult to determine (Haro et al. 2000). Demographic structure is difficult to determine because nonbreeding individuals are spread over an extremely large geographic range (U.S. Fish and Wildlife Service 2011).

3.9.2.10.4 Predator and Prey Interactions

The American eel feeds on a wide variety of prey items including benthic invertebrates, insects, crustaceans, molluscs, worms, and finfish. It is preyed upon by a wide variety of species including fish, seabirds, sharks, and rays (Dalton et al. 2009; U.S. Fish and Wildlife Service 2011).

3.9.2.10.5 Species-Specific Threats

The most important threat to the American eel is thought to be freshwater habitat loss due to urban development, water pollution, and poor fish passage through hydroelectric facilities (U.S. Fish and Wildlife Service 2011). Overfishing of American eel in commercial marine fisheries has also contributed to substantial population declines (Knights 2003). All life stages of eels are harvested and overfishing is currently occurring in the United States (Council for Endangered Species Act Reliability 2010). Disease, introduced via aquaculture facilities also threatens this species. An Asian parasite (*Anguillicola crassus*) infests and damages the eel's swim bladder, resulting in mortality of pre-migratory adults (U.S. Fish and Wildlife Service 2011).

3.9.2.11 Dwarf Seahorse (*Hippocampus zosterae*)

3.9.2.11.1 Status and Management

In April 2011, NMFS received a petition to list the dwarf seahorse as threatened or endangered under the ESA and to designate critical habitat concurrently with the listing (FR 77 (87): 26478-26486, May 4, 2012). In its 90-day review, NMFS concluded that the species may warrant listing under the ESA, resulting in the initiation of a formal status review (FR 77 (87): 26478-26486, May 4, 2012).

Dwarf seahorses are harvested in Florida's commercial seahorse fishery to support the aquaria trade, primarily in the southeast portion of the state through diving, seining, or dredging (Bruckner 2005). The state imposes a commercial bag limit of 400 dwarf seahorses per person or per vessel per day, whichever is less, and a recreational bag limit of five dwarf seahorses per person, per day. There are no seasonal restrictions or closures for this fishery (FR 77 (87): 26478-26486, May 4, 2012).

3.9.2.11.2 Habitat and Geographic Range

The dwarf seahorse has a restricted geographic range within the Study Area, inhabiting tropical and subtropical/warm-temperate waters of Florida, the Gulf of Mexico, and the Caribbean (Masonjones and Lewis 1996). It primarily occurs in south Florida estuaries and in the Florida Keys. The dwarf seahorse prefers protected bays/lagoons with low water flow, high organic content, mid- to high-salinities and depths less than 6 ft. (2 m) (Bruckner 2005; Foster and Vincent 2004). The species is almost exclusively associated with seagrass beds, particularly eelgrass (*Zostera* sp.) (Bruckner 2005). It is more abundant in areas with higher seagrass density, canopy cover, and seagrass shoot density (Bruckner 2005; Sogard et al. 1987). Other habitats used by the dwarf seahorse include mangrove areas, unattached algae, and inshore drifting vegetation (Center for Biological Diversity 2011; Hoese and Moore 1998; Tabb and Manning 1961).

While most seahorse species exhibit strong site-fidelity, in terms of home ranges and spawning habitat (Curtis and Vincent 2006; Masonjones and Lewis 1996), Masonjones et al. (2010) suggest that further seahorse dispersal outside of home ranges may occur. Dispersal may be enhanced by clinging to drifting

Sargassum or floating debris within inshore habitats (Foster and Vincent 2004; Masonjones and Lewis 1996). Spawning occurs between February and November (Foster and Vincent 2004).

Southeast U.S. Continental Shelf Large Marine Ecosystem. The dwarf seahorse's primary range includes south Florida estuaries and the Florida Keys (FR 77 (87): 26478-26486, May 4, 2012).

Gulf of Mexico Large Marine Ecosystem. Bruckner et al. (2005) report that the dwarf seahorse is uncommon in many areas in the Gulf of Mexico (FR 77 (87): 26478-26486, May 4, 2012), with fewer than 20 independent collection records from the following locations: Lower Laguna Madre, South Apalachee Bay, North Apalachee Bay, Corpus Christi Bay, St. George Sound, East Mississippi Sound, Aransas Bay, Terrebonne/Timbalier Bays, Chandeleur Sound, Perdido Bay, and Pensacola Bay (Beck and Odaya 2001).

Caribbean Sea Large Marine Ecosystem. The dwarf seahorse's primary range includes all portions of the Caribbean (FR 77 (87): 26478-26486, May 4, 2012).

3.9.2.11.3 Population and Abundance

There are no published data on current global population trends or total numbers of mature dwarf seahorses; however, some population data exist in Florida based on numbers derived from the commercial seahorse fishery. NMFS reported a five-fold increase in seahorse landings between 1991 and 1992 (from 14,000 harvested in 1991 to 83,700 harvested in 1992), with the increased landings primarily attributed to dwarf seahorses (FR 77 (87): 26478-26486, May 4, 2012). Over a longer period, the number of dwarf seahorses landed during 1990–2003 ranged from 2,142 to 98,779 individuals per year (Bruckner 2005). Additional density data are from ichthyoplankton tows conducted in portions of southern Florida and range from 0 to 6 seahorses per 100 cubic meters in subtidal pools, seagrass beds, in channels, and along restored marsh edges (Masonjones et al. 2010; Powell et al. 2002; Thayer et al. 1999).

3.9.2.11.4 Predator and Prey Interactions

Seahorses are ambush predators, consuming primarily live, mobile nekton, such as small amphipods and other invertebrates (Bruckner 2005).

3.9.2.11.5 Species-Specific Threats

Dwarf seahorses are the second most sought after fish exported from Florida in the aquarium trade (FR 77 (87): 26478-26486, May 4, 2012). They are dried and sold at curio shops as souvenirs (Bruckner 2005) and also are in high demand in the traditional Chinese medicine trade (FR 77 (87): 26478-26486, May 4, 2012).

The petition for listing (Center for Biological Diversity 2011) describes other natural or manmade factors that may be threatening the dwarf seahorse, including life history characteristics, bycatch mortality, illegal fishing, hurricanes or tropical storms, and invasive species. The petition also suggests that the current status of the dwarf seahorse may be related to low frequency boat motor noise, based on a single lab study (FR 77 (87): 26478-26486, May 4, 2012). However, the actual negative impacts of boat motor noise on the health, behavior, and reproductive success of wild populations of dwarf seahorses in their natural habitat remain unclear at this time (FR 77 (87): 26478-26486, May 4, 2012).

In addition to species-specific threats, threats to the dwarf seahorse's primary habitat of seagrass are further described in Section 3.7.2.8 (Seagrasses, Cordgrasses, and Mangroves). Additional information on threats to dwarf seahorses are detailed by NMFS and Center for Biological Diversity (Center for Biological Diversity 2011).

3.9.2.12 Nassau Grouper (*Epinephelus striatus*)

3.9.2.12.1 Status and Management

In August 2010, NMFS received a petition to list Nassau grouper as threatened or endangered under the ESA and designate critical habitat concurrently with the listing (FR 77 (196): 61559-61562, October 10, 2012). In its 90-day review, NMFS concluded that the species may warrant listing under the ESA, resulting in the initiation of a formal status review (FR 77 (196): 61559-61562, October 10, 2012).

Between 1986 and 1991, Nassau grouper commercial and recreational landings declined substantially in both pounds landed and average size. As a result, the fishery management councils of the Caribbean, South Atlantic, and Gulf of Mexico, as well as the state of Florida, all implemented moratoriums on take and possession by 1996 (National Marine Fisheries Service 2009d). Estimates by the International Union for the Conservation of Nature suggest that by 2000, species abundance had decreased approximately 60 percent over the last three generations (Cornish and Eklund 2003). This substantial decline is thought to be in large part due to intensive harvesting of spawning aggregations, which concentrate the fish in a spatially and temporally predictable fashion (Beets and Hixon 1994; Colin 1992). Failure of the species to rebound in response to fishing bans, combined with concerns over habitat degradation, have yielded new management efforts which now focus on the establishment of shelf-reef reserves (i.e., marine protected areas) as a more effective means of preserving both the species and its habitat (Koenig et al. 2000). The reserves are typically near current and historical spawning aggregation sites (Albins et al. 2009).

3.9.2.12.2 Habitat and Geographic Range

The Nassau grouper primarily occurs in association with high-relief coral reefs and rocky bottoms from inshore to a depth of approximately 330 ft. (100 m). Nassau grouper tend to rest on or near the bottom, and juveniles are most often encountered in seagrass beds and patch reefs close to shore (Bester 2012). These fish also occupy caves and large overhangs (National Marine Fisheries Service 2009d). Spawning habitat is typically at depths ranging from 65 to 130 ft. (20 to 40 m) on the edge of outer reef shelves (Science and Conservation of Reef Fish Aggregations 2012).

Southeast U.S. Continental Shelf Large Marine Ecosystem. The geographic range of Nassau grouper within this large marine ecosystem is limited to the southeast coast of Florida (FR 77 (196): 61559-61562, October 10, 2012).

Gulf of Mexico Large Marine Ecosystem. Nassau grouper generally do not occur in the Gulf of Mexico, except in the Campeche Bank; Flower Gardens Bank; Dry Tortugas National Park; and Key West, Florida (Bester 2012).

Caribbean Sea Large Marine Ecosystem. The Nassau grouper's primary range includes Bermuda, Florida, the Bahamas, Yucatan Peninsula, and throughout the Caribbean (FR 77 (196): 61559-61562, October 10, 2012). The waters around the Cayman Islands still sustain active Nassau grouper spawning aggregations which is rare for the region (Kobara and Heyman 2008; Semmens et al. 2006). Assessments of the ocean bottom at spawning aggregations in the Cayman Islands indicate that Nassau grouper occupy reef crests and shelf-edge drop-offs into deep water. These areas are thought to provide relief from predators and assist with egg dispersal (Kobara and Heyman 2008).

3.9.2.12.3 Population and Abundance

Nassau grouper congregate in large numbers at site-specific areas to spawn after the appropriate temperature and moon phase cues (usually within a period of 10 days overlapping the full moon) between January and February (Archer et al. 2012; Science and Conservation of Reef Fish Aggregations 2012; Semmens et al. 2006). Spawning aggregations of several thousand individuals have been reported in the Bahamas (Bester 2012). This species is a solitary fish apart from spawning aggregations (Starr et al. 2007).

Researchers have estimated that the current worldwide population of Nassau grouper is approximately 10,000 individuals (FR 77 (196): 61559-61562, October 10, 2012). The most recent data suggest that subpopulations are likely to either be stable (e.g., the United States) or in decline (e.g., Cuba and Belize). However, it is likely that the global population of Nassau grouper continues to decline (Cornish and Eklund 2003). Tissue analyses of individuals from Florida, Cuba, Belize, and the Bahamas indicate no evidence of genetically distinct subpopulations; thus, Nassau grouper are considered as a single population (Bernard et al. 2012; Cornish and Eklund 2003).

3.9.2.12.4 Predator and Prey Interactions

Information on predation of groupers is lacking; however, Nassau grouper are generally preyed upon by barracuda (*Sphyraena barracuda*), king mackerel (*Scomberomorus cavalla*), moray eels (*Gymnothorax* spp.) and—although rare—other groupers (Bester 2012). Sharks also feed on Nassau grouper, including sandbar sharks (e.g., *Carcharhinus plumbeus*) and great hammerhead sharks (e.g., *Sphyrna mokarran*) (Olsen and LaPlace 1978). The marine isopod *Excorallana tricornis tricornis* is a known parasite of the Nassau grouper, sometimes resulting in infestations immediately following spawning (Semmens et al. 2006).

Adult Nassau grouper are opportunistic ambush predators, feeding on a variety of fishes, shrimps, crabs, lobsters, and octopuses (see review in (Sadovy and Eklund 1999)). In contrast, juveniles show a high degree of trophic plasticity (flexibility in their diet) and incorporate filter feeding, particulate feeding, and piscivory (i.e., feeding on other fishes) in their foraging strategy. Early juveniles consume primarily dinoflagellates (greater than 99 percent by number) and fish larvae and mysids (28–79 percent by volume) (Sadovy and Eklund 1999).

3.9.2.12.5 Species-Specific Threats

Nassau grouper are especially sensitive to over-exploitation due to their slow growth, late reproduction (5+ years of age), large size, and long life-spans (Morris et al. 2000; Sadovy and Eklund 1999). The dramatic decline in Nassau grouper abundance is thought to be the result of the overharvest and subsequent collapse of spawning aggregations (Aguilar-Perera 2006; Ehrhardt and Deleveaux 2007), which predictably concentrate fish both spatially and temporally. Extirpation (i.e., local extinction) can occur quickly, sometimes within just a few years following overharvest, and can pose a more substantial risk to the population than simply overfishing the stock’s overall abundance (FR 77 (196): 61559-61562, October 10, 2012). These effects are particularly evident throughout the Caribbean (Aguilar-Perera 2006; Morris et al. 2000), where they are exacerbated by indirect impacts from coastal development (Stallings 2009).

The loss of macroalgae and seagrass beds is particularly damaging to Nassau grouper populations, as it often results in lower recruitment rates (Sadovy and Eklund 1999). Similarly, physical damage to spawning sites limits reproductive success of adults if alternative habitats are not available.

To date, fishing moratoriums and regulations have been ineffective at preventing illegal harvest—which has been occurring in Puerto Rico since the inception of the moratorium in 1992, and which may also be occurring in other U.S. waters (National Marine Fisheries Service 2009d). Severe declines have also resulted from overfishing with spear guns and exploitation of juveniles in fine mesh nets (FR 77 (196): 61559-61562, October 10, 2012).

3.9.2.13 River Herring: Alewife (*Alosa pseudoharengus*) and Blueback Herring (*Alosa aestivalis*)

Alewife and blueback herring are being evaluated jointly as "river herring" by NMFS and are, therefore, combined and referred to as river herring in this document.

3.9.2.13.1 Status and Management

Alewife and blueback herring exhibit very similar life histories, and they are often harvested and managed together because of the difficulty in distinguishing between the two species; they are currently managed by the Atlantic States Marine Fisheries Commission. Commercial harvest is on-going in Maine, New Hampshire, New York, New Jersey, Delaware, Maryland, Virginia, and South Carolina. In 2011, NMFS determined that substantial scientific information exists that listing may be warranted and is therefore conducting a status review (FR 76 (212): 67652-67656, November 2, 2011). To protect the remaining populations, the states of Massachusetts, Rhode Island, Connecticut, and North Carolina have enacted moratoriums on the harvest and possession of river herrings. The North Carolina Division of Marine Fisheries wrote a River Herring Fisheries Management Plan that outlines the recovery methods to rebuild North Carolina's river herring populations (National Marine Fisheries Service 2009e).

3.9.2.13.2 Habitat and Geographic Range

River herring typically occur over the continental shelf in waters less than 100 m (328 ft.) (Neves 1981). River herring spawn in a variety of habitats, ranging from swift moving rivers to small tributaries above the tidal zone (National Marine Fisheries Service 2009e).

Northeast U.S. Continental Shelf Large Marine Ecosystem and Southeast U.S. Continental Shelf Large Marine Ecosystem. The alewife ranges throughout the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems from Newfoundland to North Carolina (historically to South Carolina) (National Marine Fisheries Service 2009e). The blueback herring also ranges throughout the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems from Nova Scotia to the St. Johns River, Florida (McBride et al. 2010). River herring are anadromous, migrating during the spring months to spawn in their natal rivers on the U.S. east coast then returning to coastal waters in the summer. Juveniles mature for several years in coastal waters before making their first spawning run. The highly migratory river herring travel in large schools near the surface (National Marine Fisheries Service 2009e).

3.9.2.13.3 Population and Abundance

River herring have undergone substantial declines throughout most of their range. At Holyoke Dam on the Connecticut River, the total migration has dropped from about 600,000 individuals in 1985 to only 1,300 individuals in 2003 (National Marine Fisheries Service 2009e). Similar trends have been observed in Rhode Island, Massachusetts, and North Carolina. The Rhode Island Department of Environmental Management reported a 95 percent decline in river herring runs between 2000 and 2004. Similarly, alewife runs in the St. Croix River were reduced from a high of 2,624,000 fish in 1987 to 1,299 fish in 2004 (National Marine Fisheries Service 2009e).

3.9.2.13.4 Predator and Prey Interactions

All life stages of river herring feed primarily on phytoplankton and zooplankton, but adults also eat mysids, small finfish, and benthic crustaceans (National Marine Fisheries Service 2009e). River herring are preyed on by a number of marine species, including striped bass, bluefish, tunas, cod, haddock, halibut, American eel, seabirds, and mammals.

3.9.2.13.5 Species-Specific Threats

River herring have been species of concern, and now ESA candidates, because of substantial declines in populations throughout their ranges. Hydroelectric facilities (dams) with poor fish passage restrict their access to spawning and forage areas. Fish are also injured or killed by hydroelectric turbines. Degradation of water quality by toxic pollutants, nutrient discharge, and sediment loads may have also contributed to the decline of river herring. In addition, commercial marine fishing pressure exacerbates the riverine threats to the river herring (FR 76 (212): 67652-67656, November 2, 2011).

3.9.2.14 Scalloped Hammerhead Shark (*Sphyrna lewini*)

3.9.2.14.1 Status and Management

In August 2011, NMFS received a petition to list the scalloped hammerhead shark as threatened or endangered under the ESA and to designate critical habitat concurrently with the listing (FR 76 (228): 72891-72896, November 28, 2011). In its 90-day review, NMFS concluded that substantial scientific information may warrant listing under the ESA, thus initiating a status review for the scalloped hammerhead shark (FR 76 (228): 72891-72896, November 28, 2011). In April 2013, NMFS proposed listing the central and southwest Atlantic distinct population segment as threatened (FR 78 (66): 20718-20753, April 5, 2013). The scalloped hammerhead shark is managed under the Large Coastal Shark Management Unit by NMFS through the Final Consolidated Atlantic Highly Migratory Species Fisheries Management Plan (National Marine Fisheries Service 2009f). The species has a fishery management plan and designated Essential Fish Habitat.

3.9.2.14.2 Habitat and Geographic Range

The scalloped hammerhead shark is circumglobal, occurring in all temperate to tropical waters (Duncan and Holland 2006) of the Study Area from the surface to depths of 275 m (902 ft.). It typically inhabits nearshore waters of bays and estuaries where water temperatures are at least 22°C (72°F) (Castro 1983; Compagno 1984). The scalloped hammerhead shark remains close to shore during the day and moves to deeper waters at night to feed (Bester 1999). A genetic marker study suggests that females typically remain close to coastal habitats, while males are more likely to disperse across larger open ocean areas (Daly-Engel et al. 2012).

In the western Atlantic, the scalloped hammerhead's range extends from New Jersey to Brazil, including the Gulf of Mexico and the Caribbean Sea (Bester 1999). The scalloped hammerhead migrates seasonally along the eastern United States, where it may rear in coastal nursery areas (Duncan and Holland 2006). Tagging data indicate that this species may occur in the Gulf Stream, but does not typically occur in the open ocean (Kohler and Turner 2001).

Northeast U.S. Continental Shelf Large Marine Ecosystem. Juveniles inhabit shallow coastal waters of this ecosystem, from the shoreline to the 200 m (656 ft.) isobath, south of 39° N (National Marine Fisheries Service 2009). Adults range farther north to Long Island, New York, in coastal waters at depths from 25 to 200 m (82 to 656 ft.) (National Marine Fisheries Service 2009f).

Southeast U.S. Continental Shelf Large Marine Ecosystem. Neonates and young-of-the-year depend on coastal nursery areas within this ecosystem, particularly waters extending from the shoreline to 22 nm offshore of South Carolina to Florida (west of 79.5° W and north of 30° N). Juveniles depend on shallow coastal waters from the shoreline to the 200 m (656 ft.) isobath, extending south of 39° N to the vicinity of the Florida Keys (82° W) and Dry Tortugas. Adults depend on coastal waters from 25 to 200 m (82 to 656 ft.) from 36.5° N to 33° N; from 33° N south to 30° N from the 50 to 200 m (164 to 656 ft.) isobath; and from 25 to 200 m (82 to 656 ft.) from 30° N south to 28° N (National Marine Fisheries Service 2009f).

Gulf of Mexico Large Marine Ecosystem. Neonates and young-of-the-year depend on coastal nursery areas, particularly from the shoreline to 22 nm offshore of Texas to the southwest coast of Florida. Juveniles depend on shallow coastal waters, from the shoreline to the 200 m (656 ft.) isobath, extending from the southern to mid-coast of Texas, eastern Louisiana to the southwest coast of Florida. Adults depend on coastal waters from 25 to 200 m (82 to 656 ft.) along the southern Texas coast and from eastern Louisiana to the Florida Keys. Offshore areas beyond 200 m (656 ft.) depths are also important between southern Texas and eastern Louisiana (National Marine Fisheries Service 2009f).

3.9.2.14.3 Population and Abundance

NMFS data and information provided in the listing petition suggest that the scalloped hammerhead shark has undergone substantial declines throughout its range (FR 76 (228): 72891-72896, November 28, 2011). Data from 1986 to 2000 from the U.S. pelagic longline fleet indicates a decreasing trend in the abundance of the scalloped hammerhead shark (Baum et al. 2003). However, during that same timeframe, there was also some evidence of population increases or rebuilding stocks in the Southeast U.S. Continental Shelf Large Marine Ecosystem (Ward-Paige et al. 2012). Food and Agriculture Organization catch data indicate that similar fishing efforts in 2002 and 2009 achieved catches of scalloped hammerhead sharks that peaked at 8,000 metric tons in 2002 and fell to 1,000 metric tons in 2009 (Food and Agriculture Organization of the United Nations 2005, 2009).

3.9.2.14.4 Predator and Prey Interactions

Scalloped hammerhead sharks follow daily vertical movement patterns within their home range (Holland et al. 1993; Klimley and Nelson 1984), and feed primarily at night (Compagno 1984). They are a high trophic level predator, and feed opportunistically on all types of teleost fish, cephalopods, crustaceans, and rays (Bethea et al. 2011; Compagno 1984; Torres-Rojas et al. 2010; Vaske et al. 2009).

3.9.2.14.5 Species-Specific Threats

The primary threat to the scalloped hammerhead shark is direct take, especially by the foreign commercial shark fin market (FR 76 (228): 72891-72896, November 28, 2011). Scalloped hammerheads are a principal component of the total shark bycatch in the swordfish and tuna longline fishery and shrimp trawls in the Gulf of Mexico (Branstetter 2002), and are particularly susceptible to overfishing and bycatch in gillnet fisheries because of schooling habits (Food and Agriculture Organization of the United Nations 2012). Longline mortality for this species is estimated between 91 and 94 percent (FR 76 (228): 72891-72896, November 28, 2011).

3.9.2.15 Jawless Fish (Orders Myxiniformes and Petromyzontiformes)

Hagfish (Myxiniformes) are the most primitive fish group (Nelson 2006). In fact, recent taxonomic revisions suggests that Myxiniformes are not fish at all but are a "sister" group to all vertebrates (Nelson 2006). However, jawless fish are generally thought of as fish and are therefore included in this section. Hagfish occur exclusively in marine habitats, and include 70 species worldwide in temperate marine locations. This group feeds on dead or dying fish, and have few of the external features often associated with fish, such as fins and scales (Helfman et al. 2009). The members of this group are important scavengers that recycle nutrients back through the ecosystem.

Lampreys (Petromyzontiformes) are represented by 11 known marine or freshwater species distributed primarily throughout the temperate regions of the Northern Hemisphere. Lampreys typically are parasitic, feeding on other live fish. The most striking feature of the lampreys is the oral disc mouth, by which they attach themselves to other fish to feed on their blood (Moyle and Cech 1996; Nelson 2006).

Hagfish and lampreys occur in the seafloor habitats of all open ocean areas and coastal waters of the Study Area (Paxton and Eshmeyer 1998). Hagfish are typically found at depths greater than 80 ft. (25 m) and temperatures below 55°F (13°C).

3.9.2.16 Sharks, Skates, Rays, and Chimaeras (Class Chondrichthyes)

The cartilaginous (nonbony) marine fish of the class Chondrichthyes are distributed throughout the world’s oceans, occupying all areas of the water column (Paxton and Eshmeyer 1998). This group is mainly predatory, and contains many of the top predators found in the ocean, such as the white shark (*Carcharodon carcharias*), mako shark (*Isurus oxyrinchus*), and tiger shark (*Galeocerdo cuvier*) (Helfman et al. 2009). As filter-feeders, the whale shark, manta ray, and basking shark are notable exceptions.

Very little is known about the Holocephali subclass, which contains 58 marine species of chimaeras (Nelson 2006). Chimaeras are cool-water marine fish that are found at depths between 260 and 8,500 ft. (80 and 2,600 m) (Nelson 2006). They occur in the open-ocean portions of the Study Area, up to the lower continental shelf (Paxton and Eshmeyer 1998).

The subclass Elasmobranchii contains more than 850 marine species, including sharks, skates, and rays spread across nine orders (Nelson 2006). Elasmobranchs (sharks, skates, and rays) have protective tooth-like scales called placoid scales and no swim bladder. Specialized sensory systems (electroreception and mechanoreception) allow these (and other) fish to detect and respond to electrical or mechanical impulses (Jordan et al. 2011). Elasmobranchs also bear young in a variety of life history strategies, including live birth, egg-laying, or a combination of live birth and egg laying (Moyle and Cech 1996).

Sharks, skates, and rays occupy relatively shallow temperate and tropical waters throughout the world. More than half of these species occur in less than 655 ft. (200 m) of water, and nearly all are found at depths less than 6,560 ft. (2,000 m) (Nelson 2006). The dusky shark (*Carcharhinus obscurus*), night shark (*Carcharhinus signatus*), porbeagle shark (*Lamna nasus*), sand tiger shark (*Carcharias taurus*), and thorny skate (*Amblyraja radiata*) are species of concern that occur in the open-ocean and coastal waters of the Study Area, as listed in Table 3.9-1. A candidate species, the scalloped hammerhead shark (Section 3.9.2.14, Scalloped Hammerhead Shark [*Sphyrna lewini]*), also occurs in the Study Area.

3.9.2.17 Sturgeons and Gars (Orders Acipenseriformes and Lepisosteiformes)

Sturgeon (order Acipenseriformes) and gars (order Lepisosteiformes) are the most primitive orders in the class Actinopterygii (Nelson 2006). Twenty-seven species of sturgeon are found worldwide, most of which migrate between freshwater and saltwater. The Atlantic sturgeon, Gulf sturgeon, and shortnose sturgeon are ESA-listed species that occur in the Study Area (Sections 3.9.2.6, Shortnose Sturgeon [*Acipenser brevirostrum*]; 3.9.2.7, Gulf Sturgeon [*Acipenser oxyrinchus desotoi*]; and 3.9.2.8, Atlantic Sturgeon [*Acipenser oxyrinchus oxyrinchus*]).

Gars are primarily freshwater fish with a great tolerance for salinity. The most common gars in estuaries of the Study Area are the longnose gar (*Lepisosteus osseus*) and alligator gar (*Atractosteus spatula*. These top predators eat crabs, fish, and ducks in the estuaries of the Southeast U.S. Continental Shelf and Gulf of Mexico Large Marine Ecosystems (Nelson 2006; Rulifson 1991).

3.9.2.18 Eels and Bonefish (Orders Anguilliformes and Elopiformes)

These fish have a unique willow leaf-shaped leptocephalus larval stage (small head and a long, thin body). The eels (Anguilliformes) have an elongated snakelike body; most of the 780 eel species do not inhabit the deep ocean. Eels generally feed on fish or on small bottom-dwelling invertebrates, but will also take larger organisms (Helfman et al. 2009). Moray eels, snake eels, and conger eels occur in the Study Area (Paxton and Eshmeyer 1998). The order Elopiformes include two distinct groups with very different forms: the bonefish, predators in shallow tropical waters, and the little-known spiny eels, elongated seafloor feeders which feed on decaying organic matter in deep ocean areas (Paxton and Eshmeyer 1998).

Most eels inhabit shallow subtropical or tropical marine waters, although some species occur in all marine habitat types, (Paxton and Eshmeyer 1998) in the Study Area. An ESA candidate species, the American eel is described in Section 3.9.2.10 (American Eel [*Anguilla rostrata*]).

The bonefish are distributed throughout shallow tropical waters. Some common species in the Study Area are tarpon (*Atractosteus spatula*), ladyfish (*Elops saurus*), and bonefish (*Albula vulpes*). These surface-oriented predators support an important recreational fishery in the southeastern United States and the Caribbean (Froese and Pauly 2010). In contrast, the halosaurs and spiny eels are abundant, but rarely seen or captured (Bergstad et al. 2012). These fish occur at 400 to 16,000 ft. (120 to 4,900 m) in the open-ocean throughout the North Atlantic Subtropical Gyre, both on the seafloor and in the water column (Paxton and Eshmeyer 1998).

3.9.2.19 Herrings (Order Clupeiformes)

Many of the 364 species of the order Clupeiformes are in the Indo-West Pacific Ocean or the western Atlantic Ocean. Herring, menhaden, sardine, and anchovy species are well-known as valuable targets of commercial fisheries (Nelson 2006). Most clupeids form schools to help conserve energy and minimize predation (Brehmer et al. 2007) and may also facilitate some level of communication during predator avoidance (Marras et al. 2012). Herring account for a large portion of the total worldwide fish catch (Food and Agriculture Organization of the United Nations 2005, 2009) and also support complex marine food webs as a forage fish that sustains predatory fish, birds, and mammals. River herring migrate up rivers to spawn in freshwater, while Atlantic herring spawn in coastal waters. Clupeids feed on decaying organic matter and plankton while swimming in the water column (Moyle and Cech 1996). Two river herring species (alewife and blueback herring) are ESA-candidate species, as described in Section 3.9.2.13 (River Herring: Alewife [*Alosa aestivalis*] and Blueback Herring [*Alosa pseudoharengus*]).

Herring commonly swim in large schools near the surface. They are common in the coastal waters of all the large marine ecosystems in the Study Area (Paxton and Eshmeyer 1998).

3.9.2.20 Smelts and Salmonids (Orders Argentiniformes, Osmeriformes, and Salmoniformes)

The deepwater smelts of the order Argentiniformes differ from the true smelts of the order Osmeriformes in that the true smelts inhabit coastal areas. The true smelts are abundant in coastal areas throughout the Northern Hemisphere, while the deepwater smelts are limited mainly to deep ocean regions. Smelts are an important forage fish for predatory fish, birds, and marine mammals. The rainbow smelt (*Osmerus mordax*) is a species of concern in the coastal waters in the northern portion of the Study Area, as listed in Table 3.9-1.

The native distribution of Salmoniformes is restricted to the cold waters of the Northern Hemisphere. Most salmon spawn in freshwater and live in the sea; they are among the most thoroughly studied and commercially valuable fish groups in the world. Only the Atlantic salmon occurs in the Study Area, as described in Section 3.9.2.3 (Atlantic salmon [*Salmo salar*]).

3.9.2.21 Dragonfish and Lanternfish (Orders Stomiiformes and Myctophiformes)

At more than 500 species, the orders Stomiiformes and Myctophiformes make up one of the largest groups of deepwater fish, comprising nearly 60 percent of the total biomass in the deep sea (Nelson 2006). Many of the species in these orders are not very well described in the scientific literature (Nelson 2006), nor is their ecological role well understood (Helfman et al. 2009). These fish are known for their unique body forms and light-producing capabilities. Other adaptations to the deepwater habitats in which they occur include large mouths, sharp teeth, and sensory systems that allow them to find prey and avoid predators in total darkness (Haedrich 1996; Koslow 1996; Marshall 1996; Rex and Etter 1998; Warrant and Locket 2004).

The dragonfish and lanternfish typically occur from 3,280 to 16,000 ft. (1,000 to 4,900 m) in the open-ocean portions of the Study Area and throughout the North Atlantic Subtropical Gyre (Paxton and Eshmeyer 1998). Some myctophids do occur closer to the surface, where they may become prey for marine mammals.

3.9.2.22 Greeneyes, Lizardfish, Lancetfish, and Telescopefish (Order Aulopiformes)

The order Aulopiformes includes a diverse group of fish characterized by both primitive features (adipose fin, abdominal pelvic fins, rounded scales, and absence of fin spines) and advanced features (unique swim bladder and jawbone) (Paxton and Eshmeyer 1998). They are common from estuarine and coastal waters to the deep ocean. The lizardfish (Synodontidae), Bombay ducks (Harpadontidae), and greeneyes (Chlorophthalmidae) primarily occur over the continental shelf, where they rest on the bottom and ambush smaller prey fish and invertebrates (Paxton and Eshmeyer 1998). Lancetfish (Alepisauridae) are primarily mid-water column fish, but are known from the surface to deep water. Telescopefish are primarily found in deep waters from 1,640 to 3,280 ft. (500 to 1,000 m), but they can also be found at shallower depths and may approach the surface at night (Paxton and Eshmeyer 1998).

In general, greeneyes, lizardfish, and lancetfish occur in the coastal waters of the Study Area and the western portion of the Caribbean Sea Large Marine Ecosystem. Lizardfish are common coastal species of the Gulf of Mexico and figure prominently in shrimp trawls as bycatch (Cruz-Escalona et al. 2005) and telescopefish occur primarily in the deeper waters associated with the open oceans of the Study Area (Paxton and Eshmeyer 1998).

3.9.2.23 Cods and Cusk-Eels (Orders Gadiformes and Ophidiiformes)

The cods and cusk-eels include more than 900 species, several of which are important target species of commercial fisheries. The cods, or groundfish, account for a substantial portion of the world's commercial fishery landings (Food and Agriculture Organization of the United Nations 2005). Gadiforms, such as cods, are almost exclusively marine fish, inhabiting the seafloor from temperate to arctic regions, including the West Greenland Shelf, Newfoundland-Labrador Shelf, Scotian Shelf, and Northeast

U.S. Continental Shelf Large Marine Ecosystems. Cods are generally found near the bottom in these continental shelf areas, feeding on benthic organisms (Paxton and Eshmeyer 1998). The cusk (a relative of the cod, not to be confused with the cusk-eels described below) is an ESA-candidate species, described in Section 3.9.2.9 (Cusk [*Brosme brosme*]).

The order Ophidiiformes includes cusk-eels and brotulas, which have long eel-like tapering bodies and are distributed in deepwater areas throughout the tropical and temperate oceans. The characteristics of ophidiiforms are similar to those of the other deepwater groups, described in Section 3.9.2.21 (Dragonfish and Lanternfish [Orders Stomiiformes and Myctophiformes]). In addition, there are several cusk-eel species that are open-ocean or are found on the continental shelves and slopes. Cusk-eels occur near the seafloor of the tropical and temperate coastal waters of the Study Area (Paxton and Eshmeyer 1998).

3.9.2.24 Toadfish and Anglerfish (Orders Batrachoidiformes and Lophiiformes)

The toadfish and anglerfish include nearly 400 species. Many toadfish produce sounds by vibrating their swim bladders. They spawn in and around bottom structures and invest a substantial amount of parental care by defending their nests, a trait uncommon in most marine fish (Paxton and Eshmeyer 1998). The order Lophiiformes includes all of the world's anglerfish, goosefish, frogfish, batfish, and deepwater anglerfish, most of which occur in seafloor habitats of all oceans. Females of some deepwater anglerfish use highly modified "lures," containing light-emitting organs to attract prey (Helfman et al. 2009; Koslow 1996). The males of these species are small and parasitic, spending their lives attached to the side of the female (Helfman et al. 2009). These fish are also an important predator among the deepwater seafloor habitats of the Study Area (Nelson 2006). Ten families of anglerfish live in deep water and five families live on the bottom or attached to drifting seaweed in shallow water.

Toadfish occur in coastal seafloor habitats in all of the large marine ecosystems. Anglerfish are also found in seafloor habitats but across a deeper range throughout the Study Area (Froese and Pauly 2010).

3.9.2.25 Mullets, Silversides, Needlefish, and Killifish (Orders Mugiliformes, Atheriniformes, Beloniformes, and Cyprinodontiformes)

Mugiliformes (mullets) include 71 marine species that occur in coastal marine and estuarine waters of all tropical and temperate oceans. Mullets feed on decaying organic matter in estuaries using a filter-feeding mechanism with a gizzard-like digestive tract. They feed on the bottom by scooping up food and retaining it in their very small gill rakers (Moyle and Cech 1996). Atherinomorpha contains the silversides (Atheriniformes), needlefish and flyingfish (Beloniformes), and killifish (Cyprinodontiformes). Most species in these groups are important prey in all estuarine habitats in the Study Area (Paxton and Eshmeyer 1998). The key silverside (*Menidia conchorum*), mangrove rivulus (*Rivulus marmoratus*), and saltmarsh topminnow (*Fundulus jenkinsi*) are species of concern that occur in the temperate and tropical coastal waters of the Study Area, as listed in Table 3.9-1.

Most of these fish inhabit shallow surface areas near the coasts. Exceptions to this nearshore distribution are the flyingfish and halfbeaks, which occur in tropical to warm-temperate regions to the depth of light penetration. The silversides are a small inshore species often found in intertidal habitats. The Cyprinodontiformes include the killifish, which are often associated with intertidal zones and salt marsh habitats, and are highly tolerant of pollution. These fish occur in all coastal waters and open ocean areas of the Study Area (Froese and Pauly 2010).

3.9.2.26 Oarfish, Squirrelfish, and Dories (Orders Lampridiformes, Beryciformes, and Zeiformes)

Nineteen species of oarfish comprise the order Lampridiformes (Nelson 2006). They exhibit diverse body shapes, and some have a protruding mouth that allows for a suction feeding technique while feeding on plankton. Other species, including the crestfish, possess grasping teeth used to catch prey. They occur only in the mid-water column of the open ocean, and are rarely observed (Nelson 2006). Fish in the order Beryciformes are primarily poorly described nocturnal species. There are a few shallow-water exceptions, including squirrelfish, that are distributed throughout reef systems in tropical and subtropical marine regions (Nelson 2006). Squirrelfish are an important food source for subsistence fisheries in portions of the Caribbean (Froese and Pauly 2010). Squirrelfish have specialized eyes and large mouths, and primarily feed on bottom-dwelling crustaceans (Goatley and Bellwood 2009). Very little is known about the order Zeiformes, or dories, which includes some very rare families, many containing only a single species (Paxton and Eshmeyer 1998). Even general information on their biology, ecology, and behavior is limited.

Squirrelfish are common in coral reef systems in the Study Area, primarily in the Caribbean, Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems. Most of the Lampridiformes and Zeiformes are confined to seafloor regions in all coastal waters of the Study Area, as well as the open ocean areas at depths of 130–330 ft. (40–100 m) (Moyle and Cech 1996).

3.9.2.27 Pipefish and Seahorses (Order Gasterosteiformes)

Gasterosteiformes include sticklebacks, pipefish, and seahorses, many of which are common in the Study Area. Most of these species are found in brackish water throughout the world (Nelson 2006) and occur in surface, water column, and seafloor habitats. Small mouths on a long snout and armor-like scales are characteristic of this group. Most of these species exhibit a high level of male parental care, either through nest-building (sticklebacks) or brooding pouches (seahorses and pipefish), which result in relatively few young being produced (Helfman et al. 2009). This group also includes the trumpetfish and cornetfish, which are ambush predators, with large mouths used to capture smaller fish. The opossum pipefish (*Microphis brachyurus lineatus*) is a species of concern that occurs in the coastal waters in the temperate and tropical portions of the Study Area, and the dwarf seahorse is a candidate for ESA listing (Table 3.9-1 and Section 3.9.2.11, Dwarf seahorse [*Hippocampus zosterae*]).

This group is associated with tropical and temperate reef systems. They are found in the coastal waters of the Study Area in the large marine ecosystems, but not in the open ocean (Froese and Pauly 2010).

3.9.2.28 Scorpionfish (Order Scorpaeniformes)

The order Scorpaeniformes is a diverse group of more than 1,400 marine species, all with bony plates or spines near the head. This group contains the scorpionfish, waspfish, rockfish, velvetfish, pigfish, sea robins, gurnards, sculpins, snailfish, and lumpfish (Paxton and Eshmeyer 1998). Many of these fish have modified pectoral fins or suction discs adapted for inhabiting the seafloor of the marine environment, where they feed on smaller crustaceans and fish. Many of the scorpaenids boast venomous spines on their fins. Sea robins are capable of generating sounds with their swim bladders, and are among the noisiest of all fish species in the northwestern Atlantic Ocean (Moyle and Cech 1996). Lumpfish have an odd box-shaped body, and are typically found attached to the seafloor. They are also a preferred prey of sperm whales, seals, and some shark species (Moyle and Cech 1996).

Scorpionfish are widely distributed in open-ocean and coastal habitats, at all depths, throughout the world. They occur in all waters of the Study Area. Most occur in depths of less than 330 ft. (100 m), but others are found in deepwater habitat, down to 7,000 ft. (2,200 m) (Paxton and Eshmeyer 1998).

3.9.2.29 Drums, Snappers, Snooks, Temperate Basses, and Reef Fish (Families Sciaenidae, Lutjanidae, Centropomidae, Moronidae, Apogonidae, Chaetodontidae, Pomacanthidae, and Mullidae)

Perciformes is the largest order of vertebrates (Nelson 2006), including approximately 40 percent of all bony fish. Representative families are discussed in several subsections below.

The families Sciaenidae and Lutjanidae include mainly predatory coastal marine fish, including the recreationally important snappers, drums, and croakers. These fish sometimes move in schools as juveniles, and then become more solitary as they grow larger. They feed on fish and crustaceans. Drums and croakers (Sciaenidae) produce drumming sounds via their swim bladders and, like the sea robin, are among the noisiest of all fish species in the Study Area. The striped croaker is a species of concern in the coastal waters in the temperate and tropical portions of the Study Area. The snappers (Lutjanidae) are generally associated with the seafloor, and tend to congregate near structured habitats, including natural and artificial reefs and oil platforms (Moyle and Cech 1996). Snappers also generate sound (Luczkovich et al. 2008). The snooks and temperate basses are among the most popular saltwater gamefish of recreational anglers occurring primarily in nearshore coastal waters of southern Florida. Temperate basses include striped bass (*Morone saxatilis*) distributed throughout coastal portions of the Study Area. Snooks include the common snook (*Centropomus undecimalis*), which are limited to southern Florida and the southern Gulf of Mexico. Other representative families in this group include the brightly colored and diverse forms of reef-associated cardinalfish (Apogonidae), butterflyfish (Chaetodontidae), some of which generate sound, angelfish (Pomacanthidae), and goatfish (Mullidae) (Paxton and Eshmeyer 1998).

Like the scorpionfish, the drums, snappers, snooks, and temperate basses are widely distributed in open-ocean and coastal habitats throughout the world. They occur in all waters of the Study Area, but are particularly concentrated and exhibit the most varieties in depths of less than 330 ft. (100 m). They are often associated with natural or artificial reef systems in the temperate and tropical coastal waters of the Study Area (Froese and Pauly 2010).

3.9.2.30 Groupers and Sea Basses (Family Serranidae)

Sea basses and groupers are found in the coastal and offshore reef and hard bottom systems in the tropical and temperate portions of the Study Area (Burge et al. 2012). They have large eyes and mouths, and feed mostly on bottom-dwelling fish and crustaceans (Goatley and Bellwood 2009). Some groupers and sea basses are especially active foragers at twilight (Rickel and Genin 2005), while others are active during the day (Wainwright and Richard 1995). Many species of grouper use shelf-edge habitat for spawning, which may occur year-round, but peaks during two seasons: late winter and late summer through early fall (Marancik et al. 2012). Some of the serranids begin life as female and then become male as they grow larger (Moyle and Cech 1996). Their slow maturation makes them vulnerable to overharvest (International Union for Conservation of Nature 2009). The Nassau grouper (*Epinephelus striatus*) is a candidate for ESA listing (Section 3.9.2.12, Nassau grouper [*Epinephelus striatus*]) and the speckled hind (*Epinephelus drummondhayi*) and Warsaw grouper (*Epinephelus nigritus*) are species of concern; all three species occur in the coastal waters in the temperate and tropical portions of the Study Area (Table 3.9-3).

3.9.2.31 Wrasses and Parrotfish (Families Labridae and Scaridae)

Perciform fish in the suborder Labroidei include the diverse wrasses (Labridae), and parrotfish (Scaridae), many of which are associated with nearshore reefs or structures. Wrasses include both brightly colored coral reef fish and less conspicuous temperate species. Most are active during the day, and feed by ambush or other predatory methods (Wainwright and Richard 1995). Parrotfish are habitat engineers in that they convert hard coral structures to coarse sediments and release nutrients and minerals to the water (Goatley and Bellwood 2009). Similar to the Serranidae, many wrasses and parrotfish begin life as female but change into male as they grow larger, and they exhibit a variety of reproductive strategies (Moyle and Cech 1996). This group has a similar distribution as the other perciform fish described in Section 3.9.2.29 (Drums, Snappers, Snooks, Temperate Basses, and Reef Fish [Families Sciaenidae, Lutjanidae, Centropomidae, Moronidae, Apogonidae, Chaetodontidae, Pomacanthidae, and Mullidae]) and the groupers and sea basses described in Section 3.9.2.30 (Groupers and Sea Basses [Family Serranidae]).

3.9.2.32 Gobies, Blennies, and Damselfish (Suborders Gobioidei, Blennioidei, and Acanthuroidei)

Another general group of Perciform is composed of gobies, blennies, and damselfish. The seafloor-dwelling gobies make up the largest family of marine fish, the Gobiidae (Nelson 2006); these fish have modified pelvic fins that allow them to adhere to various bottom surfaces (Helfman et al. 2009). Fish of the suborder Blennioidei occur in intertidal zones throughout the world (Mahon et al. 1998; Moyle and Cech 1996; Nelson 2006). Both blennies and gobies primarily feed on seafloor detritus. The suborder Acanthuroidei contains the surgeonfish, moorish idols, butterflyfish, and rabbitfish of tropical reef systems. They scrape algae from coral reefs with small, elongated mouths. These grazers provide an important function to the reef system by controlling the growth of algae on the reef (Goatley and Bellwood 2009). Some of these species are adapted to target particular prey species; for example, the elongated snouts of butterflyfish allow them to bite off exposed parts of invertebrates (Leysen et al. 2010).

This group is widely distributed throughout the world, primarily in coastal habitats. The fish occur in all coastal waters of the Study Area, but they are mostly concentrated in depths of less than 100 ft. (31 m) (Froese and Pauly 2010).

3.9.2.33 Jacks, Tunas, Mackerels, and Billfish (Families Carangidae, Scombridae, Xiphiidae, and Istiophoridae)

The suborder Scombroidei contains some of the most voracious open-ocean predators, besides sharks: the jacks, mackerels, barracudas, billfish, and tunas (Estrada et al. 2003; Sibert et al. 2006). These fish are the fastest members of the order Perciformes. Many jacks are known to ambush their prey either at night or at twilight (Goatley and Bellwood 2009; Rickel and Genin 2005; Sancho 2000). The highly migratory tunas, mackerels, and billfish constitute a large component of the total annual worldwide catch by weight, with tunas and swordfish as the most important species (Food and Agriculture Organization of the United Nations 2005, 2009). These fish breathe by ram ventilation, in which the motion of the fish pushes oxygenated water past the gills to increase respiratory efficiency (Wegner et al. 2006). Many fish in this group undertake large-scale migrations to follow a seasonally variable prey base (Pitcher 1995). The Atlantic bluefin tuna is a NMFS Species of Concern that occurs in the Study Area, as listed in Table 3.9-1.

These fish occupy the largest area of ocean, but make up only about 2 percent of the total marine fish (Froese and Pauly 2010; Helfman et al. 2009). They are mostly found near the surface or in the upper portion of the water column, in all coastal waters and open ocean areas of the Study Area, including all of the large marine ecosystems, the Gulf Stream, and portions of the North Atlantic Subtropical Gyre.

3.9.2.34 Flounders (Order Pleuronectiformes)

The order Pleuronectiformes includes flatfish (flounders, sand dabs, soles, and tonguefish) in all marine seafloor habitats throughout the world (Nelson 2006). Fish in this group have eyes on either the left side or the right side of the head, and are not symmetrical like other fish (Saele et al. 2004). Flounders do not have swimbladders and are therefore not expected to be sensitive to underwater sounds, as discussed in Section 3.9.3 (Environmental Consequences). All flounder species are ambush predators, feeding mostly on other fish and bottom-dwelling invertebrates (Drazen and Seibel 2007; Froese and Pauly 2010). The Atlantic halibut (*Hippoglossus hippoglossus*) is a representative of this group, and is also a Species of Concern in the coastal waters in the Northeast U.S. Continental Shelf, Scotian Shelf, Newfoundland-Labrador Shelf, and West Greenland Shelf Large Marine Ecosystems of the Study Area. This group is widely distributed on the seafloor of open-ocean and coastal habitats throughout the world. They occur in all waters of the Study Area, but are particularly concentrated and diverse in depths of less than 330 ft. (100 m). This habitat is often associated with sandy bottoms in the coastal waters and open-ocean portions of the Study Area (Paxton and Eshmeyer 1998).

3.9.2.35 Triggerfish, Puffers, and Molas (Order Tetraodontiformes)

The Tetraodontiformes, including the triggerfish, filefish, puffers, and ocean sunfish, are the most highly evolved group of modern bony fish (Nelson 2006). Like the flounders, this group exhibits unusual body shapes with modified spines or other structures to deter predators. The bodies of some species are so boxlike that they cannot swim using the typical body propulsion style, but instead are propelled at slow speeds by rudimentary fins (Wainwright and Richard 1995). The ocean sunfish (*Mola* species) are the largest bony fish (Moyle and Cech 1996). They live very close to the surface, where they feed on a variety of plankton, jellyfish, crustaceans, and fish (Froese and Pauly 2010). The only natural predators of the large ocean sunfish in the Study Area are sharks and orcas (Helfman et al. 2009).

Most other fish in this group are associated with reef systems. This group is widely distributed in tropical and temperate bottom or mid-water column habitats (open-ocean and coastal) throughout the world. They occur in all waters of the Study Area, but are particularly concentrated and diverse in depths of less than 330 ft. (100 m). This habitat is often associated with natural or artificial reefs in the coastal waters and open-ocean portions of the Study Area (Paxton and Eshmeyer 1998). One major exception is the molas (ocean sunfish), which occur at the surface in all open ocean areas (Helfman et al. 2009).

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 marine fish known to occur within the Study Area. Tables 2.8-1 through 2.8-3 present the baseline and proposed training and testing activity locations for each alternative (including number of activities and ordnance expended). General characteristics of all U.S. Department of the Navy (Navy) stressors were introduced in Section 3.0.5.3 (Identification of Stressors for Analysis), and living resources' general susceptibilities to stressors were introduced in Section 3.0.5.7 (Biological Resource Methods). The stressors vary in intensity, frequency, duration, and location within the Study Area. Based on the general threats to marine fish discussed in Section 3.9.2 (Affected Environment), the stressors applicable to marine fish in the Study Area and analyzed below include the following:

- Acoustic (sonar and other non-impulsive acoustic sources, and explosives and other impulsive acoustic sources),
- Energy (electromagnetic devices, high energy lasers),
- Physical disturbance and strikes (vessels and in-water devices, military expended materials, seafloor devices),
- Entanglement (fiber optic cables and guidance wires, parachutes),
- Ingestion (munitions, fragments from munitions, military expended materials other than munitions),
- Secondary stressors.

Each component was carefully analyzed for potential impacts on fish 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 fish resources. 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 3.0.5.3 (Identification of Stressors for Analysis), and detailed in Appendix A (Navy Activities Descriptions).

3.9.3.1 Acoustic Stressors

The following sections analyze potential impacts to fish from proposed activities that involve acoustic stressors (sonar and other non-impulsive sources, and explosives and other impulsive sources).

3.9.3.1.1 Analysis Background and Framework

This section is largely based on a technical report prepared for the Navy: *Effects of Mid- and High-Frequency Sonars on Fish* (Popper 2008). Additionally, Popper and Hastings (2009b) provide a critical overview of some of the most recent research regarding potential effects of anthropogenic sound on fish. The methods used in this EIS/OEIS to predict acoustic effects on marine fish build upon the *Conceptual Framework for Assessing Effects from Sound Producing Activities* (Section 3.0.5.7.1). Additional research specific to marine fish is presented below.

Studies of the effects of human-generated sound on fish have been reviewed in numerous places (e.g. Hastings and Popper 2005; National Research Council 1994, 2003; Popper 2003; Popper 2008; Popper and Hastings 2009b; Popper et al. 2004). Most investigations, however, have been in the gray literature (non peer-reviewed reports—see (Hastings and Popper 2005; Popper 2008; Popper and Hastings 2009a) for extensive critical reviews of this material).

Fish have been exposed to short-duration, high-intensity signals such as those that might be found near high-intensity sonar, pile driving, or a seismic airgun survey. Such studies examined short-term effects that could result in death to the exposed fish, as well as hearing loss and long-term consequences. Recent experimental studies have provided additional insight into the issues (e.g.,Doksaeter et al. 2009; Govoni et al. 2003; Kane et al. 2010; McCauley et al. 2003; Popper et al. 2007; Popper et al. 2005).

3.9.3.1.1.1 Direct Injury

<u>Non-Impulsive Acoustic Sources</u>

Potential direct injuries from non-impulsive sound sources, such as sonar, are unlikely because of the relatively lower peak pressures and slower rise times than potentially injurious sources such as explosives. Non-impulsive sources also lack the strong shock wave such as that associated with an explosion. Therefore, direct injury is not likely to occur from exposure to non-impulsive sources such as sonar, vessel noise, or subsonic aircraft noise. The theories of sonar-induced acoustic resonance, neurotrauma, and lateral line system injury are discussed below. These phenomena are difficult to recreate under real-world conditions and are therefore very unlikely to occur in the natural environment.

Two studies examined the effects of mid-frequency sonar-like signals (1.5 to 6.5 kHz) on larval and juvenile fish of several species (Jørgensen et al. 2005; Kvadsheim and Sevaldsen 2005). In the first study, Jørgensen et al. (2005) exposed larval and juvenile fish to various sounds to investigate potential effects on survival, development, and behavior. The study used herring (*Clupea harengus*) (standard lengths 2 to 5 cm [0.8 to 2 inches]), Atlantic cod (*Gadus morhua*) (standard length 2 and 6 cm [0.8 to 2.3 inches]), saithe (*Pollachius virens*) (4 cm [1.6 inches]), and spotted wolffish (*Anarhichas minor*) (4 cm [1.6 inches]) at different developmental stages. The researchers placed the fish in plastic bags 10 ft. (3 m) from the sound source and exposed them to between 4 and 100 pulses of one-second duration of pure tones at 1.5, 4, and 6.5 kHz. The fish in only two groups out of the 82 tested exhibited any adverse effects. These two groups were both composed of herring and were tested with sound pressure levels of 189 dB re 1 µPa, which resulted in a post-exposure mortality of 20 to 30 percent. While statistically significant losses were documented in the two groups impacted, the researchers only tested that particular sound level once, so it is not known if this increased mortality was due to the level of the test signal or to other unknown factors. In the remaining 80 groups tested, 42 of which were replicates of herring only, there were no observed effects on growth (length and weight) or the survival of fish that were kept as long as 34 days post exposure. Direct injury effects from swim bladder resonance as a result of Navy sonar exposure have not been observed.

As reviewed in Popper and Hastings (2009a), Hastings (1990; 1995) found 'acoustic stunning' (loss of consciousness) in blue gouramis (*Trichogaster trichopterus*) following an 8-minute exposure to a 150 Hz pure tone with a peak sound pressure level of 198 dB re 1 µPa. This species of fish has an air bubble in the mouth cavity directly adjacent to the animal's braincase that may have caused this injury. Hastings (1990; 1995) also found that goldfish exposed to two hours of continuous wave sound at 250 Hz with peak pressures of 204 dB re 1 µPa, and fathead minnows exposed to 0.5 hours of 150 Hz continuous wave sound at a peak level of 198 dB re 1 µPa did not survive.

The only study on the effect of exposure of the lateral line system to continuous wave sound (conducted on one freshwater species, the Oscar [*Astronatus ocellatus*]) suggests no effect on these sensory cells by intense pure tone signals (Hastings et al. 1996).

Explosions and Other Impulsive Acoustic Sources

The greatest potential for direct, non-auditory tissue effects is primary blast injury and barotrauma following exposure to explosions. Primary blast injury refers to those injuries that result from the initial compression of a body exposed to a blast wave. Primary blast injury is usually limited to gas-containing structures (e.g., swim bladder) and the auditory system. Barotrauma refers to injuries caused when the swim bladder or other gas-filled structures vibrate in response to the signal, particularly if there is a relatively sharp rise-time and the walls of the structure strike near-by tissues and damage them.

An underwater explosion generates a shock wave that produces a sudden, intense change in local pressure as it passes through the water (U.S. Department of the Navy 1998, 2001c). Pressure waves extend to a greater distance than other forms of energy produced by the explosion (i.e., heat and light) and are therefore the most likely source of negative effects to marine life from underwater explosions

(Scripps Institution of Oceanography and National Science Foundation 2005; U.S. Department of the Navy 2001b, 2006).

The shock wave from an underwater explosion is lethal to fish at close range causing massive organ and tissue damage and internal bleeding (Keevin and Hempen 1997). At greater distance from the detonation point, the extent of mortality or injury depends on a number of factors including fish size, body shape, orientation, and species (Keevin and Hempen 1997; Wright 1982). At the same distance from the source, larger fish are generally less susceptible to death or injury, elongated forms that are round in cross-section are less at risk than deep-bodied forms, and fish oriented sideways to the blast suffer the greatest impact (Edds-Walton and Finneran 2006; O'Keeffe 1984; O'Keeffe and Young 1984; Wiley et al. 1981; Yelverton et al. 1975). Species with gas-filled organs have higher mortality than those without them (Continental Shelf Associates Inc. 2004; Goertner et al. 1994).

Two aspects of the shock wave appear most responsible for injury and death to fish: the received peak pressure and the time required for the pressure to rise and decay (Dzwilewski and Fenton 2002). Higher peak pressure and abrupt rise and decay times are more likely to cause acute pathological effects (Wright and Hopky 1998). Rapidly oscillating pressure waves might rupture the kidney, liver, spleen, and sinus and cause venous hemorrhaging (Keevin and Hempen 1997). They can also generate bubbles in blood and other tissues, possibly causing embolism damage (Ketten 1998). Oscillating pressure waves might also burst gas-containing organs. The swim bladder, the gas-filled organ used by most fish to control buoyancy, is the primary site of damage from explosives (Wright 1982; Yelverton et al. 1975). Gas-filled swim bladders resonate at different frequencies than surrounding tissue and can be torn by rapid oscillation between high- and low-pressure waves. Swim bladders are a characteristic of many bony fish but are not present in sharks and rays.

Studies that have documented fish killed during planned underwater explosions indicate that most fish that die do so within one to four hours, and almost all die within a day (Hubbs and Rechnitzer ; Yelverton et al. 1975). Fitch and Young (1948) found that the type of fish killed changed when blasting was repeated at the same marine location within 24 hours of previous blasting. They observed that most fish killed on the second day were scavengers, presumably attracted by the victims of the previous day’s blasts. However, fish collected during these types of studies have mostly been recovered floating on the water’s surface. Gitschlag et al. (2001) collected both floating fish and those that were sinking or lying on the bottom after explosive removal of nine oil platforms in the northern Gulf of Mexico. They found that 3 to 87 percent (46 percent average) of the specimens killed during a blast might float to the surface. Other impediments to accurately characterizing the magnitude of fish mortality included currents and winds that transported floating fish out of the sampling area and predation by seabirds or other fish.

There have been few studies of the impact of underwater explosions on early life stages of fish (eggs, larvae, juveniles). Fitch and Young (1948) reported the demise of larval anchovies exposed to underwater blasts off California, and Nix and Chapman (1985) found that anchovy and smelt larvae died following the detonation of buried charges. Similar to adult fish, the presence of a swim bladder contributes to shock wave-induced internal damage in larval and juvenile fish (Settle et al. 2002). Shock wave trauma to internal organs of larval pinfish and spot from shock waves was documented by Govoni et al. (2003).

It has been suggested that impulsive sounds, such as those produced by seismic airguns, may cause damage to the cells of the lateral line in fish larvae and juveniles when in proximity (5 m [16 ft.]) to the sound source (Booman et al. 1996).

There have been a number of studies that suggest that the sounds from impact pile driving, and particularly from driving of larger piles, kill fish that are very close to the source. The source levels in such cases often reach peak sound pressure levels of 193 to 212 dB re 1 µPa and there is some evidence of tissue damage accompanying exposure (e.g., Abbott and Reyff 2004; California Department of Transportation 2001) reviewed in (Hastings and Popper 2005). However, there is reason for concern in analysis of such data since; in many cases the only dead fish observed were those that came to the surface. It is not clear whether fish that did not come to the surface survived the exposure to the sounds, or died and were carried away by currents.

There are also a number of non-peer reviewed experimental studies that placed fish in cages at different distances from the pile driving operations and attempted to measure mortality and tissue damage as a result of sound exposure. However, in most cases the studies' (Abbott et al. 2002; Abbott and Reyff 2004; Abbott et al. 2005; California Department of Transportation 2001; Nedwell et al. 2003) work was done with few or no controls, and the behavioral and histopathological observations done very crudely (the exception being Abbott et al. 2005). As a consequence of these limited and unpublished data, it is not possible to know the real effects of pile driving on fish.

Interim criteria for injury of fish were discussed in Stadler and Woodbury (2009). The onset of physical injury would be expected if either the peak sound pressure level exceeds 206 dB re 1 µPa, or the cumulative sound exposure level, accumulated over all pile strikes generally occurring within a single day, exceeds 187 dB referenced 1 micropascal squared second (dB re 1 μPa^2-s) for fish 2 grams or larger, or 183 dB re 1 μPa^2-s for smaller fish (Stadler and Woodbury 2009). A more recent study by Halvorsen et al. (2011) used carefully controlled laboratory conditions to determine the level of pile driving sound that may cause a direct injury to the fish tissues (barotrauma). The investigators found that juvenile Chinook salmon (*Oncorhynchus tshawytscha*) that received less than a single strike sound exposure level of 179 to 181 dB re 1 μPa^2-s and cumulative sound exposure level of less than 211 dB re 1 μPa^2-s over the duration of the pile driving event would sustain no more than mild, non-life-threatening injuries.

3.9.3.1.1.2 Hearing Loss

Exposure to high intensity sound can cause hearing loss, also known as a noise-induced threshold shift, or simply a threshold shift (Miller 1974). A temporary threshold shift (TTS) is a temporary, recoverable loss of hearing sensitivity. A TTS may last several minutes to several weeks and the duration may be related to the intensity of the sound source and the duration of the sound (including multiple exposures). A PTS is non-recoverable, results from the destruction of tissues within the auditory system, and can occur over a small range of frequencies related to the sound exposure. As with temporary threshold shift, the animal does not become deaf but requires a louder sound stimulus (relative to the amount of PTS) to detect a sound within the affected frequencies; however, in this case, the effect is permanent.

Permanent hearing loss, or PTS has not been documented in fish. The sensory hair cells of the inner ear in fish can regenerate after they are damaged, unlike in mammals where sensory hair cells loss is permanent (Lombarte et al. 1993; Smith et al. 2006). As a consequence, any hearing loss in fish may be as temporary as the timeframe required to repair or replace the sensory cells that were damaged or destroyed (e.g., Smith et al. 2006).

Non-Impulsive Acoustic Sources

Studies of the effects of long-duration sounds with sound pressure levels below 170–180 dB re 1 µPa indicate that there is little to no effect of long-term exposure on species that lack notable anatomical hearing specialization (Amoser and Ladich 2003; Scholik and Yan 2001; Smith et al. 2004a, b; Wysocki et al. 2007). The longest of these studies exposed young rainbow trout (*Onorhynchus mykiss*), to a level of noise equivalent to one that fish would experience in an aquaculture facility (e.g., on the order of 150 dB re 1 µPa) for about nine months. The investigators found no effect on hearing (i.e., TTS) as compared to fish raised at 110 dB re 1 µPa.

In contrast, studies on fish with hearing specializations (i.e., greater sensitivity to lower sound pressures and higher frequencies) show there is some hearing loss after several days or weeks of exposure to increased background sounds, although the hearing loss seems to recover (e.g., (Scholik and Yan 2002; Smith et al. 2006; Smith et al. 2004a). Smith et al. (2006; 2004b) exposed goldfish to noise at 170 dB re 1 µPa and found a clear relationship between the amount of hearing loss (TTS) and the duration of exposure until maximum hearing loss occurred after 24 hours of exposure. A ten-minute exposure resulted in a 5 dB TTS, whereas a three-week exposure resulted in a 28 dB TTS that took over two weeks to return to pre-exposure baseline levels (Smith et al. 2004a) (Note: recovery time not measured by investigators for shorter exposure durations).

Similarly, Wysocki and Ladich (2005) investigated the influence of noise exposure on the auditory sensitivity of two freshwater fish with notable hearing specializations, the goldfish and the lined Raphael catfish (*Platydoras costatus*), and on a freshwater fish without notable specialization, the pumpkinseed sunfish (*Lepomis gibbosus*). Baseline thresholds showed greatest hearing sensitivity around 0.5 kHz in the goldfish and catfish and at 0.1 kHz in the sunfish. For the goldfish and catfish, continuous white noise of approximately 130 dB re 1 µPa at 1 m resulted in a significant TTS of 23 to 44 dB. In contrast, the auditory thresholds in the sunfish declined by 7 to 11 dB. The duration of exposure and time to recovery was not addressed in this study. Scholik and Yan (2001) demonstrated TTS in fathead minnows (*Pimephales promelas*) after a 24-hour exposure to white noise (0.3–2.0 kHz) at 142 dB re 1 µPa, that did not recover as long as 14 days post-exposure.

Studies have also examined the effects of the sound exposures from Surveillance Towed Array Sensor System Low-Frequency Active sonar on fish hearing (Kane et al. 2010; Popper et al. 2007). Hearing was measured both immediately post exposure and for several days thereafter. Maximum received sound pressure levels were 193 dB re 1 µPa for 324 or 628 seconds. Catfish and some specimens of rainbow trout showed 10-20 dB of hearing loss immediately after exposure to the low-frequency active sonar when compared to baseline and control animals; however, another group of rainbow trout showed no hearing loss. Recovery in trout took at least 48 hours, but studies were not completed. The different results between rainbow trout groups is difficult to understand, but may be due to developmental or genetic differences in the various groups of fish. Catfish hearing returned to, or close to, normal within about 24 hours after exposure to low-frequency active sonar. Furthermore, examination of the inner ears of the fish during necropsy (note: maximum time fish were held post exposure before sacrifice was 96 hours) revealed no differences from the control groups in ciliary bundles or other features indicative of hearing loss (Kane et al. 2010).

The study of mid-frequency active sonar by the same investigators also examined potential effects on fish hearing and the inner ear (Halvorsen et al. 2012; Kane et al. 2010). Out of the four species tested (rainbow trout, channel catfish, largemouth bass, and yellow perch) only one group of channel catfish, tested in December, showed any hearing loss after exposure to mid-frequency active sonar. The signal consisted of a 2-second-long, 2.8–3.8 kHz frequency sweep followed by a 3.3 kHz tone of 1 second duration. The stimulus was repeated five times with a 25 second interval. The maximum received sound pressure level was 210 dB re 1 µPa. These animals, which have the widest hearing range of any of the species tested, experienced approximately 10 dB of threshold shift that recovered within 24 hours. Channel catfish tested in October did not show any hearing loss. The investigators speculated that the difference in hearing loss between catfish groups might have been due to the difference in water temperature of the lake where all of the testing took place (Seneca Lake, New York) between October and December. Alternatively, the observed hearing loss differences between the two catfish groups might have been due to differences between the two stocks of fish (Halvorsen et al. 2012). Any effects on hearing in channel catfish due to sound exposure appear to be transient (Halvorsen et al. 2012; Kane et al. 2010). Investigators observed no damage to ciliary bundles or other features indicative of hearing loss in any of the other fish tested including the catfish tested in October (Kane et al. 2010).

Some studies have suggested that there may be some loss of sensory hair cells due to high intensity sources; however, none of these studies concurrently investigated effects on hearing. Enger (1981) found loss of ciliary bundles of the sensory cells in the inner ears of Atlantic cod (*Gadus morhua*) following 1-5 hours of exposure to pure tone sounds between 50 and 400 Hz with a sound pressure level of 180 dB re 1 µPa. Hastings (1995) found auditory hair-cell damage in a species with notable anatomical hearing specializations, the goldfish (*Carassius auratus*) exposed to 250 Hz and 500 Hz continuous tones with maximum peak levels of 204 dB re 1 µPa and 197 dB re 1 µPa, respectively, for about two hours. Similarly, Hastings et al. (1996) demonstrated damage to some sensory hair cells in oscars (*Astronotus ocellatus*) following a one hour exposure to a pure tone at 300 Hz with a peak pressure level of 180 dB re 1 µPa. In none of the studies was the hair cell loss more than a relatively small percent (less than a maximum of 15 percent) of the total sensory hair cells in the hearing organs.

Explosions and Other Impulsive Acoustic Sources

Popper et al. (2005) examined the effects of a seismic airgun array on a fish with hearing specializations, the lake chub (*Couesius plumbeus*), and two species that lack notable specializations, the northern pike (*Esox lucius*) and the broad whitefish (*Coregonus nasus*) (a salmonid). In this study the average received exposure levels were a mean peak pressure level of 207 dB re 1 µPa; sound pressure level of 197 dB re 1 µPa; and single-shot sound exposure level of 177 dB re 1 μPa^2-s. The results showed temporary hearing loss for both lake chub and northern pike to both 5 and 20 airgun shots, but not for the broad whitefish. Hearing loss was approximately 20 to 25 dB at some frequencies for both the northern pike and lake chub, and full recovery of hearing took place within 18 hours after sound exposure. Examination of the sensory surfaces of the ears by an expert on fish inner ear structure showed no damage to sensory hair cells in any of the fish from these exposures (Song et al. 2008).

McCauley et al. (2003) showed loss of a small percent of sensory hair cells in the inner ear of the pink snapper (*Pagrus auratus*) exposed to a moving airgun array for 1.5 hours. Maximum received levels exceeded 180 dB re 1 μPa^2-s for a few shots. The loss of sensory hair cells continued to increase for up to at least 58 days post exposure to 2.7 percent of the total cells, with disproportionate damage (approximately 15 percent of hair cells) in the caudal portion of the ear. It is not known if this hair cell loss would result in hearing loss since fish have tens or even hundreds of thousands of sensory hair cells in the inner ear (Lombarte and Popper 1994; Popper and Hoxter 1984) and only a small portion were affected by the sound. The question remains as to why McCauley et al. (2003) found damage to sensory hair cells while Popper et al. (2005) did not. There are many differences between the studies, including species, precise sound source, and spectrum of the sound that it is hard to speculate.

Hastings et al. (2008) exposed the pinecone soldierfish (*Myripristis murdjan*), a fish with anatomical specializations to enhance their hearing; and three species without notable specializations: the blue green damselfish (*Chromis viridis*), the saber squirrelfish (*Sargocentron spiniferum*), and the bluestripe seaperch (*Lutjanus kasmira*) to an airgun array. Fish in cages in 5 m (16 ft.) of water were exposed to multiple airgun shots with a cumulative sound exposure level of 190 dB re 1 μPa^2-s. The authors found no hearing loss in any fish following exposures.

As with other impulsive sound sources, it is assumed that sound from pile driving may cause hearing loss in fish located near the site (Popper and Hastings 2009a); however, research definitively demonstrating this is lacking.

3.9.3.1.1.3 Auditory Masking

Auditory masking refers to the presence of a noise that interferes with a fish's ability to hear biologically relevant sounds. Fish use sounds to detect predators and prey, and for schooling, mating, and navigating, among other uses (Myrberg 1980; Popper et al. 2003). Masking of sounds associated with these behaviors could have impacts to fish by reducing their ability to perform these biological functions.

Any noise (i.e., unwanted or irrelevant sound, often of an anthropogenic nature) detectable by a fish can prevent the fish from hearing biologically important sounds including those produced by prey or predators (Myrberg 1980; Popper et al. 2003). Auditory masking may take place whenever the noise level heard by a fish exceeds ambient noise levels, the animal's hearing threshold, and the level of a biologically relevant sound. Masking is found among all vertebrate groups, and the auditory system in all vertebrates, including fish, is capable of limiting the effects of masking noise, especially when the frequency range of the noise and biologically relevant signal differ (Fay 1988; Fay and Megela-Simmons 1999).

The frequency of the sound is an important consideration for fish because many marine fish are limited to detection of the particle motion component of low frequency sounds at relatively high sound intensities (Amoser and Ladich 2005). The frequency of the acoustic stimuli must first be compared to the animal's known or suspected hearing sensitivity to establish if the animal can potentially detect the sound.

One of the problems with existing fish auditory masking data is that the bulk of the studies have been done with goldfish, a freshwater fish with well-developed anatomical specializations that enhance hearing abilities. The data on other species are much less extensive. As a result, less is known about masking in marine species, many of which lack the notable anatomical hearing specializations. However, Wysocki and Ladich (2005) suggest that ambient sound regimes may limit acoustic communication and orientation, especially in animals with notable hearing specializations.

Tavolga (1974a, b) studied the effects of noise on pure-tone detection in two species without notable anatomical hearing specializations, the pin fish (*Lagodon rhomboids*) and the African mouth-breeder (*Tilapia macrocephala*), and found that the masking effect was generally a linear function of masking level, independent of frequency. In addition, Buerkle (1968, 1969) studied five frequency bandwidths for Atlantic cod in the 20 to 340 Hz region and showed masking across all hearing ranges. Chapman and Hawkins (1973) found that ambient noise at higher sea states in the ocean has masking effects in cod, *Gadus morhua*, haddock, *Melanogrammus aeglefinus*, and pollock, *Pollochinus pollachinus*, and similar results were suggested for several sciaenid species by Ramcharitar and Popper (2004). Thus, based on limited data, it appears that for fish, as for mammals, masking may be most problematic in the frequency region near the signal.

There have been a few field studies that may suggest masking could have an impact on wild fish. Gannon et al. (2005) showed that bottlenose dolphins (*Tursiops truncatus*) move toward acoustic playbacks of the vocalization of Gulf toadfish (*Opsanus beta*). Bottlenose dolphins employ a variety of vocalizations during social communication including low-frequency pops. Toadfish may be able to best detect the low-frequency pops since their hearing is best below 1 kHz, and there is some indication that toadfish have reduced levels of calling when bottlenose dolphins approach (Remage-Healey et al. 2006). Silver perch have also been shown to decrease calls when exposed to playbacks of dolphin whistles mixed with other biological sounds (Luczkovich et al. 2000). Results of the Luczkovich et al. (2000) study, however, must be viewed with caution because it is not clear what sound may have elicited the silver perch response (Ramcharitar et al. 2006). Astrup (1999) and Mann et al. (1998) hypothesized that high frequency detecting species (e.g., clupeids) may have developed sensitivity to high frequency sounds to avoid predation by odontocetes. Therefore, the presence of masking noise may hinder a fish's ability to detect predators and therefore increase predation.

Of considerable concern is that human-generated sounds could mask the ability of fish to use communication sounds, especially when the fish are communicating over some distance. In effect, the masking sound may limit the distance over which fish can communicate, thereby having an impact on important components of their behavior. For example, the sciaenids, which are primarily inshore species, are one of the most active sound producers among fish, and the sounds produced by males are used to "call" females to breeding sights (Ramcharitar et al. 2001) reviewed in (2006). If the females are not able to hear the reproductive sounds of the males, there could be a significant impact on the reproductive success of a population of sciaenids. Since most sound production in fish used for communication is generally below 500 Hz (Slabbekoorn et al. 2010), sources with significant low-frequency acoustic energy could affect communication in fish.

Also potentially vulnerable to masking is navigation by larval fish, although the data to support such an idea are still exceedingly limited. There is indication that larvae of some reef fish (species not identified in study) may have the potential to navigate to juvenile and adult habitat by listening for sounds emitted from a reef (either due to animal sounds or non-biological sources such as surf action) (e.g., Higgs 2005). In a study of an Australian reef system, the sound signature emitted from fish choruses was between 0.8 and 1.6 kHz (Cato 1978) and could be detected by hydrophones 3 to 4 nm from the reef (McCauley and Cato 2000b). This bandwidth is within the detectable bandwidth of adults and larvae of the few species of reef fish, such as the damselfish, *Pomacentrus partitus,* and bicolor damselfish, *Eupomacentrus partitus,* that have been studied (Kenyon 1996; Myrberg 1980). At the same time, it has not been demonstrated conclusively that sound, or sound alone, is an attractant of larval fish to a reef, and the number of species tested has been very limited. Moreover, there is also evidence that larval fish may be using other kinds of sensory cues, such as chemical signals, instead of, or alongside of, sound (Atema et al. 2002).

3.9.3.1.1.4 Physiological Stress and Behavioral Reactions

As with masking, a fish must first be able to detect a sound above its hearing threshold for that particular frequency and the ambient noise before a behavioral reaction or physiological stress can occur. There are little data available on the behavioral reactions of fish, and almost no research conducted on any long-term behavioral effects or the potential cumulative effects from repeated exposures to loud sounds (Popper and Hastings 2009a).

Stress refers to biochemical and physiological responses to increases in background sound. The initial response to an acute stimulus is a rapid release of stress hormones into the circulatory system, which may cause other responses such as elevated heart rate and blood chemistry changes. Although an increase in background sound has been shown to cause stress in humans, only a limited number of studies have measured biochemical responses by fish to acoustic stress (e.g., Remage-Healey et al. 2006; Smith et al. 2004b; Wysocki et al. 2007; Wysocki et al. 2006) and the results have varied. There is evidence that a sudden increase in sound pressure level or an increase in background noise levels can increase stress levels in fish (Popper and Hastings 2009a). Exposure to acoustic energy has been shown to cause a change in hormone levels (physiological stress) and altered behavior in some species such as the goldfish (*Carassius auratus*) (Pickering 1981; Smith et al. 2004a, b), but not all species tested to date, such as the rainbow trout (*Oncorhynchus mykiss*) (Wysocki et al. 2007).

Behavioral effects to fish could include disruption or alteration of natural activities such as swimming, schooling, feeding, breeding, and migrating. Sudden changes in sound level can cause fish to dive, rise, or change swimming direction. There is a lack of studies that have investigated the behavioral reactions of unrestrained fish to anthropogenic sound. Studies of caged fish have identified three basic behavioral reactions to sound: startle, alarm, and avoidance (McCauley et al. 2000; Pearson et al. 1992; Scripps Institution of Oceanography and National Science Foundation 2008). Changes in sound intensity may be more important to a fish's behavior than the maximum sound level. Sounds that fluctuate in level tend to elicit stronger responses from fish than even stronger sounds with a continuous level (Schwartz 1985).

Non-Impulsive Acoustic Sources

Remage-Healey et al. (2006) found elevated cortisol levels, a stress hormone, in Gulf toadfish (*Opsanus beta*) exposed to low frequency bottlenose dolphin sounds. Additionally, the toadfish' call rates dropped by about 50 percent, presumably because the calls of the toadfish, a primary prey for bottlenose dolphins, give away the fish's location to the dolphin. The researchers observed none of these effects in toadfish exposed to an ambient control sound (i.e., low-frequency snapping shrimp 'pops').

Smith et al. (2004b) found no increase in corticosteroid, a stress hormone, in goldfish (*Carassius auratus*) exposed to a continuous, band-limited noise (0.1 – 10 kHz) with a sound pressure level of 170 dB re 1 µPa for one month. Wysocki et al. (2007) exposed rainbow trout (*Onorhynchus mykiss*) to continuous band-limited noise with a sound pressure level of about 150 dB re 1 µPa for nine months with no observed stress effects. Growth rates and effects on the trout's immune system were not significantly different from control animals held at sound pressure level of 110 dB re 1 µPa.

Gearin et al. (2000) studied responses of adult sockeye salmon (*Oncorhynchus nerka*) and sturgeon (*Acipenser* sp.) to pinger sounds produced by acoustic devices designed to deter marine mammals from gillnet fisheries. The pingers produced sounds with broadband energy with peaks at 2 kHz or 20 kHz. They found that fish did not exhibit any reaction or behavior change to the pingers, which demonstrated that the alarm was either inaudible to the salmon and sturgeon, or that neither species was disturbed by the mid-frequency sound (Gearin et al. 2000). Based on hearing threshold data, it is highly likely that the salmonids did not hear the sounds.

Culik et al. (2001) did a very limited number of experiments to determine the catch rate of herring (*Clupea harengus*) in the presence of pingers producing sounds that overlapped with the frequency range of hearing for herring (base frequency of 2.7 kHz with harmonics to 19 kHz). They found no change in catch rates in gill nets with or without the higher frequency (greater than 20 kHz) sounds present, although there was an increase in the catch rate with the signals from 2.7 kHz to 19 kHz (a different source than the higher frequency source). The results could mean that the fish did not "pay attention" to the higher frequency sound or that they did not hear it, but that lower frequency sounds may be attractive to fish. At the same time, it should be noted that there were no behavioral observations on the fish, and so how the fish actually responded when they detected the sound is not known.

Doksæter et al. (2009) studied the reactions of wild, overwintering herring to Royal Netherlands Navy experimental mid-frequency active sonar and killer whale feeding sounds. The behavior of the fish was monitored using upward looking echosounders. The received levels from the 1-2 kHz and 6-7 kHz sonar signals ranged from 127-197 dB re 1 µPa and 139-209 dB re 1 µPa, respectively. Escape reactions were not observed upon the presentation of the mid-frequency active sonar signals; however, the playback of the killer whale sounds elicited an avoidance reaction. The authors concluded that these mid-frequency sonars could be used in areas of overwintering herring without substantially affecting the fish.

There is evidence that elasmobranchs respond to human-generated sounds. Myrberg and colleagues did experiments in which they played back sounds and attracted a number of different shark species to the sound source (e.g., Myrberg et al. 1969; Myrberg et al. 1976; Myrberg et al. 1972; Nelson and Johnson 1972). The results of these studies showed that sharks were attracted to low-frequency sounds (below several hundred Hz), in the same frequency range of sounds that might be produced by struggling prey. However, sharks are not known to be attracted by continuous signals or higher frequencies (which they presumably cannot hear because their best hearing sensitivity is around 20 Hz, and drops off above 1,000 Hz (Casper and Mann 2006; 2009)).

Studies documenting behavioral responses of fish to vessels show that Barents Sea capelin (*Mallotus villosus*) may exhibit avoidance responses to engine noise, sonar, depth finders, and fish finders (Jørgensen et al. 2004). Avoidance reactions are quite variable depending on the type of fish, its life history stage, behavior, time of day, and the sound propagation characteristics of the water (Schwartz 1985). Misund (1997) found that fish ahead of a ship, that showed avoidance reactions, did so at ranges of 160 to 490 ft. (49–150 m). When the vessel passed over them, some species of fish responded with sudden escape responses that included lateral avoidance or downward compression of the school.

In a study by Chapman and Hawkins (1973) the low-frequency sounds of large vessels or accelerating small vessels caused avoidance responses by herring. Avoidance ended within 10 seconds after the vessel departed. Twenty-five percent of the fish groups habituated to the sound of the large vessel and 75 percent of the responsive fish groups habituated to the sound of small boats.

Explosions and Other Impulsive Acoustic Sources

Pearson et al. (1992) exposed several species of rockfish (*Sebastes* spp.) to a seismic airgun. The investigators placed the rockfish in field enclosures and observed the fish's behavior while firing the airgun at various distances for 10 minute trials. Dependent upon the species, rockfish exhibited startle or alarm reactions between peak to peak sound pressure level of 180 dB re 1 µPa and 205 dB re 1 µPa. The authors reported the general sound level where behavioral alterations became evident was at about 161 dB re 1 µPa for all species. During all of the observations, the initial behavioral responses only lasted for a few minutes, ceasing before the end of the 10-minute trial.

Similarly, Skalski et al. (1992) showed a 52 percent decrease in rockfish (*Sebastes* spp.) caught with hook-and-line (as part of the study – fisheries independent) when the area of catch was exposed to a single airgun emission at 186-191 dB re 1 µPa (mean peak level) (See also Pearson et al. 1987, 1992). They also demonstrated that fish would show a startle response to sounds as low as 160 dB re 1 µPa, but this level of sound did not appear to elicit decline in catch. Wright (1982) also observed changes in fish behavior as a result of the sound produced by an explosion, with effects intensified in areas of hard substrate.

Wardle et al. (2001) used a video system to examine the behaviors of fish and invertebrates on reefs in response to emissions from seismic airguns. The researchers carefully calibrated the airguns to have a peak level of 210 dB re 1 µPa at 16 m and 195 dB re 1 µPa at 109 m from the source. There was no indication of any observed damage to the marine organisms. They found no substantial or permanent changes in the behavior of the fish or invertebrates on the reef throughout the course of the study, and no marine organisms appeared to leave the reef.

Engås et al. (1996) and Engås and Løkkeborg (2002) examined movement of fish during and after a seismic airgun study by measuring catch rates of haddock (*Melanogrammus aeglefinus*) and Atlantic cod (*Gadus morhua*) as an indicator of fish behavior using both trawls and long-lines as part of the experiment. These investigators found a significant decline in catch of both species that lasted for several days after termination of airgun use. Catch rate subsequently returned to normal. The conclusion reached by the investigators was that the decline in catch rate resulted from the fish moving away from the airgun sounds at the fishing site. However, the investigators did not actually observe behavior, and it is possible that the fish just changed depth.

The same research group showed, more recently, parallel results for several additional pelagic species including blue whiting and Norwegian spring spawning herring (Slotte et al. 2004). However, unlike earlier studies from this group, the researchers used fishing sonar to observe behavior of the local fish schools. They reported that fish in the area of the airguns appeared to go to greater depths after the airgun exposure compared to their vertical position prior to the airgun usage. Moreover, the abundance of animals 30–50 km away from the ensonification increased, suggesting that migrating fish would not enter the zone of seismic activity.

Alteration in natural behavior patterns due to exposure to pile driving noise has not been well studied. However, one study (Mueller-Blenkle et al. 2010) demonstrated behavioral reactions of cod (*Gadus morhua*) and Dover sole (*Solea solea*) to pile driving sounds. Sole showed a significant increase in swimming speed. Cod reacted, but not significantly, and both species showed directed movement away from the sources with signs of habituation after multiple exposures. For sole, reactions were seen with peak sound pressure levels of 144 – 156 dB re 1 µPa; and cod showed altered behavior at peak sound pressure levels of 140 – 161 dB re 1 µPa. For both species, this corresponds to a peak particle motion between 6.51×10^{-3} and 8.62×10^{-4} m/s^2.

3.9.3.1.2 Impacts from Sonar and Other Non-Impulsive Acoustic Sources

Non-impulsive sources from the Proposed Action include sonar and other active acoustic sources, vessel noise, and subsonic aircraft noise. Potential acoustic effects to fish from non-impulsive sources may be considered in four categories, as detailed above in Section 3.9.3.1.1 (Analysis Background and Framework): (1) direct injury; (2) hearing loss; (3) auditory masking; and (4) physiological stress and behavioral reactions.

As discussed in Section 3.9.3.1.1.1 (Direct Injury), direct injury to fish as a result of exposure to non-impulsive sounds is highly unlikely to occur. Therefore, direct injury as a result of exposure to non-impulsive sound sources is not discussed further in this analysis.

Research discussed in Section 3.9.3.1.1.2 (Hearing Loss), indicates that exposure of fish to transient, non-impulsive sources is unlikely to result in any hearing loss. Most sonar sources are outside of the hearing and sensitivity range of most marine fish, and noise sources such as vessel movement and aircraft overflight lack the duration and intensity to cause hearing loss. Furthermore, PTS has not been demonstrated in fish as they have been shown to regenerate lost sensory hair cells. Therefore, hearing loss as a result of exposure to non-impulsive sound sources is not discussed further in this analysis.

3.9.3.1.2.1 No Action Alternative – Training Activities

As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.8-1, and Section 3.0.5.3.1.1 (Sonar and Other Active Acoustic Sources), training activities under the No Action Alternative include activities that produce in-water noise from the use of sonar and other active acoustic sources. Activities could occur throughout the Study Area but would be concentrated in Virginia Capes (VACAPES), Navy Cherry Point, and Jacksonville (JAX) Range Complexes, with lesser numbers of events in the Gulf of Mexico (GOMEX) and Northeast Range Complexes. These Navy range complexes are within the Northeast and Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems and the Gulf Stream Open Ocean Area. Sonar and other active acoustic sources proposed for use are transient in most locations as active sonar activities pass through the Study Area. A few activities involving sonar and other active acoustic sources occur in inshore water (within bays, rivers, and estuaries), specifically at pierside locations. Sonar maintenance activities that would occur at pierside locations occur infrequently and typically emit only a few pings per event.

Only a few species of shad within the Clupeidae family (herrings) are known to be able to detect high-frequency sonar and other active acoustic sources (greater than 10,000 Hz). Other marine fish would probably not detect these sounds and would therefore experience no stress, behavioral disturbance, or auditory masking. Shad species, especially in nearshore and inland areas where mine warfare activities take place that often employ high-frequency sonar systems, could have behavioral reactions and experience auditory masking during these events. However, mine warfare activities are typically limited in duration and geographic extent. Furthermore, sound from high-frequency systems may only be detectable above ambient noise regimes in these coastal habitats from within a few kilometers. Behavioral reactions and auditory masking if they occurred for some shad species are expected to be transient. Long-term consequences for the population would not be expected.

Most marine fish species are not expected to be able to detect sounds in the mid-frequency range of the operational sonars. The fish species that are known to detect mid-frequencies (some sciaenids [drum], most clupeids [herring], and potentially deep-water fish such as myctophids [lanternfish]) do not have their best sensitivities in the range of the operational sonars. Thus, these fish may only detect the most powerful systems, such as hull mounted sonar within a few kilometers; and most other, less powerful mid-frequency sonar systems, for a kilometer or less. Due to the limited time of exposure due to the moving sound sources, most mid-frequency active sonar used in the Study Area would not have the potential to substantially mask key environmental sounds or produce sustained physiological stress or behavioral reactions. Furthermore, although some species may be able to produce sound at higher frequencies (greater than 1 kHz), vocal marine fish, such as sciaenids, largely communicate below the range of mid-frequency levels used by most sonars. Other marine species probably cannot detect mid-frequency sonar (1,000 – 10,000 Hz) and therefore impacts are not expected for these fish. However, any such effects would be temporary and infrequent as a vessel operating mid-frequency sonar transits an area. As such, sonar use is unlikely to impact fish species. Long-term consequences for fish populations due to exposure to mid-frequency sonar and other active acoustic sources are not expected.

A large number of marine fish species may be able to detect low-frequency sonars and other active acoustic sources. However, low-frequency active usage is rare and most low-frequency active operations are conducted in deeper waters, usually beyond the continental shelf break. The majority of fish species, including those that are the most highly vocal, exist on the continental shelf and within nearshore, estuarine areas. Fish within a few tens of kilometers around a low-frequency active sonar could experience brief periods of masking, physiological stress, and behavioral disturbance while the system is used, with effects most pronounced closer to the source. However, overall effects would be localized and infrequent. Based on the low level and short duration of potential exposure to low-frequency sonar and other active acoustic sources, long-term consequences for fish populations are not expected.

As discussed in Section 3.0.5.3.1.6 (Vessel Noise), training activities under the No Action Alternative include vessel movement in many events. Navy vessel traffic could occur anywhere within the Study Area; however, it would be concentrated near the Norfolk and Mayport Navy ports and within the VACAPES, Cherry Point, and JAX Range Complexes. In a study of Navy vessel traffic, traffic was heaviest just offshore of Norfolk and Jacksonville, as well as along the coastal waters between the two ports (Mintz and Filadelfo 2011). Activities involving vessel movements occur intermittently and are variable in duration, ranging from a few hours up to two weeks. Additionally, a variety of smaller craft would be operated within the Study Area. Small craft types, sizes and speeds vary. These events would be spread across the large marine ecosystems and open ocean areas designated within the Study Area. Vessel movements involve transit to and from ports to various locations within the Study Area, and many ongoing and proposed training and testing activities within the Study Area involve maneuvers by various types of surface ships, boats, and submarines (collectively referred to as vessels).

Vessel noise has the potential to expose fish to sound and general disturbance, which could result in short-term behavioral or physiological responses (e.g., avoidance, stress, increased heart rate). Training and testing events involving vessel movements occur intermittently and range in duration from a few hours up to a few weeks. These activities are widely dispersed throughout the Study Area. While vessel movements have the potential to expose fish occupying the water column to sound and general disturbance, potentially resulting in short-term behavioral or physiological responses, such responses would not be expected to compromise the general health or condition of individual fish. In addition, most activities involving vessel movements are infrequent and widely dispersed throughout the Study Area. The exception is for pierside activities, although these areas are located in inshore, these are industrialized areas that are already exposed to high levels of anthropogenic noise due to numerous waterfront users (e.g., industrial and marinas). Therefore, impacts from vessel noise would be temporary and localized. Long-term consequences for the population are not expected.

As described in Section 3.0.5.3.1.7 (Aircraft Overflight Noise), training activities under the No Action Alternative include fixed- and rotary-wing aircraft overflights. Certain portions of the Study Area, such as areas near Navy airfields, installations, and ranges are used more heavily by Navy aircraft than other portions. These events would be spread across the large marine ecosystems and open ocean areas designated within the Study Area. A detailed description of aircraft noise as a stressor is provided in Section 3.0.5.3.1.7 (Aircraft Overflight Noise). Aircraft produce extensive airborne noise from either turbofan or turbojet engines. A severe but infrequent type of aircraft noise is the sonic boom, produced when the aircraft exceeds the speed of sound. Rotary wing aircraft (helicopters) produce low-frequency sound and vibration (Pepper et al. 2003).

Fish may be exposed to aircraft-generated noise wherever aircraft overflights occur; however, sound is primarily transferred into the water from air in a narrow cone under the aircraft. Most of these sounds would occur near airbases and fixed ranges within each range complex. Some species of fish could respond to noise associated with low-altitude aircraft overflights or to the surface disturbance created by downdrafts from helicopters. Aircraft overflights have the potential to affect surface waters and, therefore, to expose fish occupying those upper portions of the water column to sound and general disturbance potentially resulting in short-term behavioral or physiological responses. If fish were to respond to aircraft overflights, only short-term behavioral or physiological reactions (e.g., swimming away and increased heart rate) would be expected. Therefore, long-term consequences for individuals would be unlikely and long-term consequences for the populations are not expected.

Atlantic Salmon (Endangered Species Act-Listed)

Atlantic salmon, as summarized in Section 3.9.2.3 (Atlantic salmon [*Salmo salar*]), are anadromous and spend a portion of their lives in both the marine environment as well as in the riverine and estuarine systems of the northeast United States and Canada. Atlantic salmon have the potential to be exposed to non-impulsive sound associated with training activities under the No Action Alternative in the Northeast Range Complexes within the Northeast U.S. Continental Shelf Large Marine Ecosystem.

As discussed previously, Atlantic salmon are unable to detect the sound produced by mid- or high-frequency sonar and other active acoustic sources (Section 3.9.2.1, Hearing and Vocalization). Therefore acoustic impacts from these sources are not expected.

Low-frequency active sonar and other active acoustic sources are not typically operated in the Northeast Range Complexes or in coastal or nearshore waters. If low frequency sources are used in the Northeast Range Complexes, then adult Atlantic salmon in the open ocean could be exposed to sound within their hearing range within these areas. If this did occur, salmon could experience behavioral reactions, physiological stress, and auditory masking, although these impacts would be expected to be short-term and infrequent based on the low probability of co-occurrence between the activity and species. Long-term consequences for the populations would not be expected.

The primary exposure to vessel and aircraft noise would occur around the Navy ranges, ports, and air bases. Vessel and aircraft overflight noise have the potential to expose Atlantic salmon to sound and general disturbance, potentially resulting in short-term behavioral responses. Atlantic salmon are more susceptible to encounters with these sounds since they typically travel in schools within the top 10 ft. (3 m) of the water column (Hedger et al. 2009). However, as discussed above, any short-term behavioral reactions, physiological stress, or auditory masking are unlikely to lead to long-term consequences for individuals. Therefore, long-term consequences for populations are not expected.

While the entire Kennebec River system surrounding the shipyard is considered critical habitat for the species as a result of its use as a spawning and nursery area, the shipyard in Bath, Maine has been excluded for national security reasons. The designated primary constituent elements (sites for spawning and incubation, sites for juvenile rearing, and sites for migration) for Atlantic salmon critical habitat do not occur within the Study Area and therefore, the proposed training activities would not affect the critical habitat.

Largetooth Sawfish (Endangered Species Act-Listed)

The historical range of the largetooth sawfish in the waters of the United States originally included the shallow waters of the entire Gulf of Mexico, as reviewed in Section 3.9.2.4.2 (Habitat and Geographic Range). However, confirmed sightings of these fish have not occurred in U.S. waters since 1961 (FR 74 (144): 37671-37674, July 29, 2009). As noted, due to the overall lack of any confirmed largetooth sawfish sightings in U.S. waters over the last five decades, it is highly unlikely that largetooth sawfish will co-occur with any Navy training activities.

Due to their preference for shallow, nearshore waters (less than 33 ft. [10 m]) (FR 74 (144): 37671-37674, July 29, 2009), it is unlikely that largetooth sawfish would encounter any use of mid-frequency active sonar during training activities in the GOMEX Range Complex. It is possible that if there were largetooth sawfish present, exposure to mid-frequency active sonar may occur during pierside surface ship maintenance activities occurring at naval ports within the Gulf of Mexico. As discussed previously (Section 3.9.2.1, Hearing and Vocalization), largetooth sawfish are unlikely to be able to detect the sound produced by mid- or high-frequency sonar and other active acoustic sources. Therefore, acoustic impacts from these sources are not expected.

Low-frequency active sonar and other active acoustic sources are typically used in deeper water beyond the shelf break, well beyond preferred largetooth sawfish habitat. In addition, given the absence of any sightings of this species in U.S. waters over the last five decades, it is highly unlikely that any largetooth sawfish would be present in areas where low-frequency active sonar and other active acoustic sources would be in use. Nevertheless, in the unlikely event that it were to occur, in the open ocean these fish could be exposed to sound within their hearing range. If this did occur, they could experience behavioral reactions, physiological stress, and auditory masking, although these impacts would be expected to be short-term and infrequent based on the low probability of co-occurrence between the activity and species. Long-term consequences for the population would not be expected.

The primary exposure to vessel and aircraft noise would occur around the Navy ranges, ports, and air bases. Vessel and aircraft overflight noise have the potential to expose largetooth sawfish to sound and general disturbance, potentially resulting in short-term behavioral responses as the sound source quickly passes. However, as discussed above, largetooth sturgeon are believed to be largely absent from the Northern Gulf of Mexico based onhistorical sightings and are therefore unlikely to be exposed to these noises. If this were to occur, however, any short-term behavioral reactions, physiological stress, or auditory masking are unlikely to lead to long-term consequences for individuals. Therefore, long-term consequences for the population are not expected.

Smalltooth Sawfish (Endangered Species Act-Listed)

The distribution of the smalltooth sawfish has contracted greatly over the past several decades and is believed to be restricted now primarily to Florida waters (Simpfendorfer 2006; Simpfendorfer and Wiley 2006), as described in Section 3.9.2.5.2 (Habitat and Geographic Range). However, verified encounters over the past 15 years have been noted within the Panama City OPAREA and the Key West Range Complex in the Gulf of Mexico; in the JAX Range Complex along the east coast of the United States; and at the Naval Surface Warfare Center, Panama City Division Testing Range (Simpfendorfer 2006). Typically, smalltooth sawfish prefer nearshore, coastal habitats, but it is not uncommon for larger adults to occur in deeper waters ranging from 230 to 400 ft. (70 to 120 m) in depth (Poulakis and Seitz 2004; Simpfendorfer 2006).

While unlikely, due to their preference for shallow, nearshore habitats, smalltooth sawfish may occur in areas that coincide with training activities involving active high- and mid-frequency sonar, particularly in the JAX and Key West Range Complexes and in the Panama City OPAREA. Smalltooth sawfish may also be exposed to sonar noise during pierside mid-frequency sonar maintenance activities occurring at the Naval Base Mayport in Jacksonville, Florida and Port Canaveral in Port Canaveral, Florida. As discussed previously (Section 3.9.2.1, Hearing and Vocalization), smalltooth sawfish are unlikely to be able to detect the sound produced by mid- or high-frequency sonar and other active acoustic sources. Therefore, acoustic impacts from these sources are not expected.

Low-frequency active sonar is used in the JAX Range Complex and could co-occur with the habitat of the smalltooth sawfish in the deeper waters near and seaward of the continental shelf break. The low frequency sound emitted by these sonars may be within the hearing range of smalltooth sawfish. Consequently, it is possible that exposure to the sound may result in an increase in the stress level of the fish, elicit a behavioral response, or cause auditory masking. However, any exposure to low-frequency active noise would be infrequent and brief.

The primary exposure to vessel and aircraft noise would occur around the Navy ranges, ports, and air bases. Vessel and aircraft overflight noise have the potential to expose smalltooth sawfish to sound and general disturbance, potentially resulting in short-term behavioral responses as the sound source quickly passes. However, as discussed above, any short-term behavioral reactions, physiological stress, or auditory masking are unlikely to lead to long-term consequences for individuals. Therefore, long-term consequences for populations are not expected.

As discussed in Section 3.9.2.5.1 (Status and Management), the Key West Range Complex does not overlap critical habitat areas; the northeastern boundary (W-174G) of the Key West Range Complex is within approximately 9 nm of critical habitat at its closest point. Therefore proposed training activities are unlikely to take place within smalltooth sawfish critical habitat, although sound from activities involving non-impulsive sound sources that take place near the Key West Range Complex boundary may be present within the critical habitat. The primary constituent elements (i.e., red mangroves and shallow water less than 3 ft. [0.9 m] deep) would not be affected.

Shortnose Sturgeon (Endangered Species Act-Listed)

As discussed in Section 3.9.2.6.2 (Habitat and Geographic Range), shortnose sturgeon, which primarily inhabit rivers and estuaries, are not expected to occur in portions of the Study Area located in the Atlantic Ocean (Dadswell 2006; National Marine Fisheries Service 1998). Individuals generally remain within their natal river or estuary, only occasionally moving to marine environments (Dadswell et al. 1984). In addition, shortnose sturgeon rarely occur in the lower Chesapeake Bay portion of the Study Area. The current Chesapeake Bay system population appears to be centered in the upper Chesapeake Bay (Welsh et al. 2002). However, the species is known to frequent other inshore portions of the Study Area, including the Kennebec River in Maine, St. Johns River in Florida, and Kings Bay in Georgia.

As a result of their preference for inshore and nearshore environments (Dadswell 2006; National Marine Fisheries Service 1998), shortnose sturgeon would be exposed to activities associated with the proposed action very infrequently. However, shortnose sturgeon could be exposed to mid-frequency sonar during pierside surface ship sonar maintenance activities occurring at the Naval Submarine Base Kings Bay in Kings Bay, Georgia, and the Naval Base Mayport in Jacksonville, Florida. As discussed previously (Section 3.9.2.1, Hearing and Vocalization), shortnose sturgeon are unlikely to be able to detect the sound produced by mid- or high-frequency sonar and other active acoustic sources. Therefore, acoustic impacts from these sources are not expected.

The primary exposure to vessel and aircraft noise would occur around the Navy ranges, ports, and air bases. Vessel and aircraft overflight noise have the potential to expose shortnose sturgeon to sound and general disturbance, potentially resulting in short-term behavioral responses as the sound source quickly passes. However, as discussed above, any short-term behavioral reactions, physiological stress, or auditory masking are unlikely to lead to long-term consequences for individuals. Therefore, long-term consequences for populations are not expected.

Gulf Sturgeon (Endangered Species Act-Listed)

As discussed in Section 3.9.2.7.2 (Habitat and Geographic Range), Gulf sturgeon, when not spawning in the rivers, are found in the Gulf of Mexico in nearshore and inshore waters. They typically range in distribution from Louisiana through the panhandle of Florida (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2009).

Due to their preference for shallow, nearshore waters (less than 20 ft. [6 m]) (Fox et al. 2000; Fox et al. 2002), it is unlikely that Gulf sturgeon would encounter any use of mid-frequency active sonar during training activities in the GOMEX Range Complex. It is possible that were Gulf sturgeon present, exposure to mid-frequency active sonar may occur during pierside surface ship maintenance activities occurring at naval ports within the Gulf of Mexico. As discussed previously (Section 3.9.2.1, Hearing and Vocalization), Gulf sturgeon are unlikely to be able to detect the sound produced by mid- or high-frequency sonar and other active acoustic sources. Therefore, acoustic impacts from these sources are not expected.

Low-frequency active sonar and other active acoustic sources are typically used in deeper water beyond the shelf break, well away from potential Gulf sturgeon habitat. Nevertheless, Gulf sturgeon in the open ocean could be exposed to sound within their hearing range. If this did occur, they could experience behavioral reactions, physiological stress, and auditory masking, although these impacts would be expected to be short-term and infrequent based on the low probability of co-occurrence between the activity and species. Long-term consequences for the populations would not be expected.

The primary exposure to vessel and aircraft noise would occur around the Navy ranges, ports, and air bases. Vessel and aircraft overflight noise have the potential to expose Gulf sturgeon to sound and general disturbance, potentially resulting in short-term behavioral responses as the sound source quickly passes. However, as discussed above, any short-term behavioral reactions, physiological stress, or auditory masking are unlikely to lead to long-term consequences for individuals. Therefore, long-term consequences for populations are not expected.

Proposed training activities overlap designated critical habitat for Gulf sturgeon within one mile of the coastline and at pierside locations in the eastern Gulf of Mexico as discussed in Section 3.9.2.7.1 (Status and Management). The primary constituent elements are generally not applicable to the Study Area since they occur within the riverine habitat of the species. The use of non-impulsive sources in Gulf sturgeon critical habitat are unlikely to interfere with the individuals' safe and unobstructed passage between riverine, estuarine and marine habitats. Therefore, non-impulsive sound sources used in proposed training activities are unlikely to affect Gulf sturgeon designated critical habitat.

Atlantic Sturgeon (Endangered Species Act-Listed)

As discussed in Section 3.9.2.8 (Atlantic Sturgeon [*Acipenser oxyrinchus oxyrinchus]*), Atlantic sturgeon, when not in the rivers during spawning season, inhabit estuarine and marine waters of the Atlantic coast out to a depth of 164 ft. (50 m) (Bain 1997). Atlantic sturgeon are found along nearly the entire east coast of the United States from the St. Croix River in Maine south to the St. Johns River in Florida.

While unlikely, due to their preference for shallow, nearshore habitats, Atlantic sturgeon may occur in areas that coincide with training activities involving active sonar, particularly in the Northeast, VACAPES, Navy Cherry Point, and JAX Range Complexes. Atlantic sturgeon may also be exposed to sonar noise during pierside surface ship sonar maintenance activities occurring at Naval Submarine Base in Groton, Connecticut; Norfolk Naval Base in Virginia; Joint Expeditionary Base Little Creek in Norfolk, Virginia; Naval Submarine Base Kings Bay in Georgia; and Naval Base Mayport in Florida. As discussed previously (see Section 3.9.2.1, Hearing and Vocalization), Atlantic sturgeon are unlikely to be able to detect the sound produced by mid- or high-frequency sonar and other active acoustic sources. Therefore, acoustic impacts from these sources are not expected.

Low-frequency active sonar and other active acoustic sources are typically used in deeper water beyond the shelf break, well away from potential Atlantic sturgeon habitat. Nevertheless, Atlantic sturgeon in the open ocean could be exposed to sound within their hearing range. If this did occur, they could experience behavioral reactions, physiological stress, and auditory masking, although these impacts would be expected to be short-term and infrequent based on the low probability of co-occurrence between the activity and species. Long-term consequences for the populations would not be expected.

The primary exposure to vessel and aircraft noise would occur around the Navy ranges, ports, and air bases. Vessel and aircraft overflight noise have the potential to expose Atlantic sturgeon to sound and general disturbance, potentially resulting in short-term behavioral responses as the sound source quickly passes. However, as discussed above, any short-term behavioral reactions, physiological stress, or auditory masking are unlikely to lead to long-term consequences for individuals. Therefore, long-term consequences for populations are not expected.

Conclusion

Impacts to fish due to non-impulsive sound are expected to be limited to short-term, minor behavioral reactions. Long-term consequences for populations would not be expected.

Pursuant to the ESA, the use of sonar and other non-impulsive acoustic sources for training activities as described under the No Action Alternative:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, shortnose sturgeon, Atlantic sturgeon, Gulf sturgeon, smalltooth sawfish, and largetooth sawfish;*
- *will have no effect on designated critical habitat for Atlantic salmon and smalltooth sawfish; and*
- *may affect but is not likely to adversely affect designated Gulf sturgeon critical habitat.*

3.9.3.1.2.2 No Action Alternative – Testing Activities

As described in Chapter 2 (Description of Proposed Action and Alternatives), Tables 2.8-2 to 2.8-3, and in Section 3.0.5.3.1 (Acoustic Stressors), testing activities under the No Action Alternative include activities that use sonar and other active acoustic sources that produce underwater sound. These activities would be concentrated in the Northeast Range Complexes and the Rhode Island inland waters, with lesser amounts of activity in the GOMEX Range Complex and the Naval Surface Warfare Center, Panama City

Division Testing Range. VACAPES, JAX, and Key West Range Complexes also host a significant number testing activities. Within these range complexes, activities involving the use of sonar and other active acoustic sources are concentrated in the Northeast U.S. Continental Shelf, as well as the Gulf of Mexico Large Marine Ecosystems. Proposed testing activities under the No Action Alternative that involve sonar and other active acoustic sources differ in number and location from training activities under the No Action Alternative; however, the types and severity of impacts would not be discernible from those described above in Section 3.9.3.1.2.1 (No Action Alternative – Training Activities).

As discussed in Section 3.0.5.3.1.6 (Vessel Noise), testing activities under the No Action Alternative include vessel movement in many events. Navy vessel traffic associated with testing could take place anywhere within the Study Area primarily concentrated within the VACAPES, Navy Cherry Point, and JAX Range Complexes as well as the Northeast Range Complexes and adjacent inland waters; and in the Gulf of Mexico, especially in areas near Naval Surface Warfare Center, Panama City Division Testing Range. Activities involving vessel movements occur intermittently and are variable in duration, ranging from a few hours up to two weeks. Additionally, a variety of smaller craft will be operated within the Study Area. Small craft types, sizes, and speeds vary. During testing, speeds generally range from 10 to 14 knots; however, vessels can and will, on occasion, operate within the entire spectrum of their specific operational capabilities. In all cases, the vessels would be operated in a safe manner consistent with the local conditions. These events would be spread across the large marine ecosystems and open ocean areas designated within the Study Area. Proposed testing activities under the No Action Alternative that involve vessel movement differ in number and location from training activities under the No Action Alternative; however, the types and severity of impacts would not be discernible from those described above in Section 3.9.3.1.2.1 (No Action Alternative – Training Activities).

As discussed in Section 3.0.5.3.1.7 (Aircraft Overflight Noise), testing activities under the No Action Alternative include fixed- and rotary-wing aircraft overflights. Certain portions of the Study Area, such as areas near Navy airfields, installations, and ranges are used more heavily by Navy aircraft than other portions. These events would be spread across the large marine ecosystems and open ocean areas designated within the Study Area. Proposed testing activities under the No Action Alternative that involve aircraft overflights differ in number and location from training activities under the No Action Alternative; however, the types and severity of impacts would not be discernible from those described above in Section 3.9.3.1.2.1 (No Action Alternative – Training Activities).

Impacts to fish due to non-impulsive sound are expected to be limited to short-term, minor behavioral reactions. Long-term consequences for populations would not be expected. Predicted impacts to Endangered Species Act-listed fish species and any designated critical habitat would not be discernible from those described above in Section 3.9.3.1.2.1 (No Action Alternative – Training Activities).

Pursuant to the ESA, the use of sonar and other non-impulsive acoustic sources during testing activities as described under the No Action Alternative:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, shortnose sturgeon, Atlantic sturgeon, Gulf sturgeon, smalltooth sawfish, and largetooth sawfish;*
- *will have no effect on designated critical habitat for Atlantic salmon and smalltooth sawfish; and*
- *may affect but is not likely to adversely affect designated Gulf sturgeon critical habitat.*

3.9.3.1.2.3 Alternative 1 – Training Activities

As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.8-1 and Section 3.0.5.3.1.1 (Sonar and Other Active Acoustic Sources), the number of annual training activities that produce in-water noise from the use of sonar and other active acoustic sources under Alternative 1 would increase; however, the locations, types, and severity of impacts would not be discernible from those described above in Section 3.9.3.1.2.1 (No Action Alternative – Training Activities).

As discussed in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.8-1, and Section 3.0.5.3.1.6 (Vessel Noise), training activities, under Alternative 1 include an increase in the numbers of activities that involve vessels compared to the No Action Alternative; however, the locations and predicted impacts would not differ. Proposed training activities under Alternative 1 that involve vessel movement differ in number from training activities proposed under the No Action Alternative; however, the locations, types, and severity of impacts would not be discernible from those described above in Section 3.9.3.1.2.1 (No Action Alternative – Training Activities).

As discussed in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.8-1, and Section 3.0.5.3.1.7 (Aircraft Overflight Noise), training activities under Alternative 1 include an increase in the number of activities that involve aircraft as compared to the No Action Alternative; however, the training locations, types of aircraft, and types of activities would not differ. The number of individual predicted impacts associated with Alternative 1 aircraft overflight noise may increase; however, the locations, types, and severity of impacts would not be discernible from those described above in Section 3.9.3.1.2.1 (No Action Alternative – Training Activities).

Impacts to fish due to non-impulsive sound are expected to be limited to short-term, minor behavioral responses, physiological stress, and short periods of auditory masking; however, long-term consequences for populations would not be expected. Predicted impacts to ESA-listed fish species and designated critical habitat would not be discernible from those described above in Section 3.9.3.1.2.1 (No Action Alternative – Training Activities).

Pursuant to the ESA, the use of sonar and other non-impulsive acoustic sources during training activities as described under Alternative 1:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, shortnose sturgeon, Atlantic sturgeon, Gulf sturgeon, smalltooth sawfish, and largetooth sawfish;*
- *will have no effect on designated critical habitat for Atlantic salmon and smalltooth sawfish; and*
- *may affect but is not likely to adversely affect designated Gulf sturgeon critical habitat.*

3.9.3.1.2.4 Alternative 1 – Testing Activities

As described in Chapter 2 (Description of Proposed Action and Alternatives), Tables 2.8-2 to 2.8-3, and Section 3.0.5.3.1 (Acoustic Stressors), the number of annual testing activities that produce in-water sound from the use of sonar and other active acoustic sources analyzed under Alternative 1 would increase over what was analyzed for the No Action Alternative. These activities would happen in the same general locations under Alternative 1 as described under the No Action Alternative in Section 3.9.3.1.2.2 (No Action Alternative – Testing Activities).

In addition to unmanned underwater vehicle demonstrations described under the No Action Alternative conducted once per five-year period at both Naval Surface Warfare Center, Panama City Division Testing Range and Naval Undersea Warfare Center Division, Newport Testing Range, one unmanned underwater vehicle demonstration per five-year period could be conducted at the South Florida Ocean Measurement Facility Testing Range near Fort Lauderdale, Florida under Alternative 1. These activities would mean in increase in high-frequency sonar use in these areas once during a five year period. As described in Section 3.9.3.1.2.2 (No Action Alternative – Testing Activities), these non-impulsive sources may impact a few species that inhabit nearshore waters with hearing above 1,000 Hz (e.g., clupeids, some species of reef-fish, and some species of sciaenid); however, due to the infrequent nature of this activity, long-term consequences for populations in these areas would not be expected.

As discussed in Chapter 2 (Description of Proposed Action and Alternatives), Tables 2.8-2 through 2.8-3, and Section 3.0.5.3.1.6 (Vessel Noise), testing activities proposed under Alternative 1, would increase Navy vessel traffic from the No Action Alternative, leading to an increase in vessel-related noise in some portions of the Study Area. Additional ship trials will be conducted in the Northeast, VACAPES, JAX and GOMEX Range Complexes, and activities that include the use of vessels would increase at the South Florida Ocean Measurement Facility Testing Range. New vessels proposed for testing under Alternative 1, such as the Littoral Combat Ship, the Joint High Speed Vessel, and the Expeditionary Fighting Vehicle, are all fast moving, designed to operate in nearshore waters, and may increase overall noise levels in these environments. Proposed testing activities under Alternative 1 that produce underwater noise from vessel movement differ in number and location from training activities proposed under the No Action Alternative; however, the types and severity of impacts would not be discernible from those described above in Section 3.9.3.1.2.2 (No Action Alternative – Testing Activities). Long-term consequences to populations due to the proposed activities are not expected.

As discussed in Chapter 2 (Description of Proposed Action and Alternatives), Tables 2.8-2 and 2.8-3, and Section 3.0.5.3.1.7 (Aircraft Overflight Noise), testing activities under Alternative 1 include an increase in the number of events that involve aircraft as compared to the No Action Alternative; however, the testing locations, types of aircraft, and types of activities would not differ. The number of individual predicted impacts associated with Alternative 1 aircraft overflight noise may increase; however, the locations, types, and severity of impacts would not be discernible from those described above in Section 3.9.3.1.2.2 (No Action Alternative – Testing Activities). Long-term consequences to populations due to the proposed activities are not expected.

Impacts to fish due to non-impulsive sound are expected to be limited to short-term, minor behavioral responses, physiological stress, and short period of auditory masking; however, long-term consequences for populations would not be expected. Predicted impacts to Endangered Species Act-listed fish species and designated critical habitat would not be discernible from those described above in Section 3.9.3.1.2.2 (No Action Alternative – Testing Activities). Long-term consequences to populations due to the proposed activities are not expected.

Pursuant to the ESA, the use of sonar and other non-impulsive acoustic sources during testing activities as described under Alternative 1:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, shortnose sturgeon, Atlantic sturgeon, Gulf sturgeon, smalltooth sawfish, and largetooth sawfish;*
- *will have no effect on designated critical habitat for Atlantic salmon and smalltooth sawfish; and*
- *may affect but is not likely to adversely affect designated Gulf sturgeon critical habitat.*

3.9.3.1.2.5 Alternative 2 – Training Activities (Preferred Alternative)

Proposed training activities under Alternative 2 are identical to training activities proposed under Alternative 1. Therefore, the predicted impacts for Alternative 2 are identical to those described above in Training Activities under Section 3.9.3.1.2.3 (Alternative 1 – Training Activities).

Pursuant to the ESA, the use of sonar and other non-impulsive acoustic sources during training activities as described under Alternative 2:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, shortnose sturgeon, Atlantic sturgeon, Gulf sturgeon, smalltooth sawfish, and largetooth sawfish;*
- *will have no effect on designated critical habitat for Atlantic salmon and smalltooth sawfish; and*
- *may affect but is not likely to adversely affect designated Gulf sturgeon critical habitat.*

3.9.3.1.2.6 Alternative 2 – Testing Activities (Preferred Alternative)

As described in Chapter 2 (Description of Proposed Action and Alternatives), Tables 2.8-2 to 2.8-3, and Section 3.0.5.3.1 (Acoustic Stressors), the number of annual testing activities that use sonar and other active acoustic sources analyzed under Alternative 2 would increase over what was analyzed for the No Action Alternative. Proposed testing activities under Alternative 2 that produce underwater sound from sonar and other active acoustic sources differ in number from testing activities proposed under Alternative 1; however, the locations, types, and severity of impacts would not be discernible from those described above in Section 3.9.3.1.2.4 (Alternative 1 – Testing Activities).

As discussed in Chapter 2 (Description of Proposed Action and Alternatives), Tables 2.8-2 through 2.8-3, and Section 3.0.5.3.1.6 (Vessel Noise), testing activities proposed under Alternative 2, would increase the number of testing activities that use Navy vessels, leading to an increase in vessel-related noise in some portions of the Study Area as described under testing activities for Alternative 1 (Section 3.9.3.1.2.4, Alternative 1 – Testing Activities). Proposed testing activities under Alternative 2 that produce underwater noise from vessel movement differ in number from testing activities proposed under Alternative 1; however, the locations, types, and severity of impacts would not be discernible from those described above in Section 3.9.3.1.2.4 (Alternative 1 – Testing Activities).

As discussed in Chapter 2 (Description of Proposed Action and Alternatives), Tables 2.8-2 through 2.8-3, and Section 3.0.5.3.1.7 (Aircraft Overflight Noise), testing activities under Alternative 2 include an increase in the number of events that involve aircraft as compared to the No Action Alternative; however, the testing locations, types of aircraft, and types of activities would not differ. Proposed testing activities under Alternative 2 that involve aircraft participation differ in number from testing activities proposed under Alternative 1; however, the locations, types, and severity of impacts would not be discernible from those described above in Section 3.9.3.1.2.4 (Alternative 1 – Testing Activities).

Impacts to fish due to non-impulsive sound are expected to be limited to short-term, minor behavioral responses, physiological stress, and short period of auditory masking; however, long-term consequences for populations would not be expected. Predicted impacts to Endangered Species Act-listed fish species and designated critical habitat would not be discernible from those described above in Section 3.9.3.1.2.4 (Alternative 1 – Testing Activities).

Pursuant to the ESA, the use of sonar and other non-impulsive acoustic sources during testing activities as described under Alternative 2:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, shortnose sturgeon, Atlantic sturgeon, Gulf sturgeon, smalltooth sawfish, and largetooth sawfish;*
- *will have no effect on designated critical habitat for Atlantic salmon and smalltooth sawfish; and*
- *may affect but is not likely to adversely affect designated Gulf sturgeon critical habitat.*

3.9.3.1.3 Impacts from Explosives and Other Impulsive Acoustic Sources

Explosions and other impulsive sound sources include explosions from underwater detonations and explosive munitions, swimmer defense airguns, pile driving, and noise from weapons firing, launch, and impact with the water's surface. Potential acoustic effects to fish from impulsive sound sources may be considered in four categories, as detailed above in Section 3.9.3.1 (Acoustic Stressors) (1) direct injury; (2) hearing loss; (3) auditory masking; and (4) physiological stress and behavioral reactions.

Concern about potential fish mortality associated with the use of at-sea explosives led military researchers to develop mathematical and computer models that predict safe ranges for fish and other animals from explosions of various sizes (e.g., Goertner 1982; Goertner et al. 1994; Yelverton et al. 1975). Young (1991) provides equations that allow estimation of the potential effect of underwater explosions on fish possessing swim bladders using a damage prediction method developed by Goertner (1982). Young's parameters include the size of the fish and its location relative to the explosive source, but are independent of environmental conditions (e.g., depth of fish and explosive shot frequency). An example of such model predictions is shown in Table 3.9-5, which lists estimated explosive-effects ranges using Young's (1991) method for fish possessing swim bladders exposed to explosions that would typically occur during training exercises. The 10 percent mortality range is the distance beyond which 90 percent of the fish present would be expected to survive. It is difficult to predict the range of more subtle effects causing injury but not mortality (Continental Shelf Associates Inc. 2004).

Table 3.9-5: Estimated Explosive Effects Ranges for Fish with Swim Bladders

Training Operation and Type of Ordnance	NEW (lb.)	Depth of Explosion (ft.)	10% Mortality Range (ft.)		
			1-oz. Fish	1-lb. Fish	30-lb. Fish
Mine Neutralization					
MK-103 Charge	0.002	10	40	28	18
AMNS Charge	3.24	20	366	255	164
20-lb. NEW UNDET Charge	20	30	666	464	299
Missile Exercise					
Hellfire	8	3.3	317	221	142
Maverick	100	3.3	643	449	288
Firing Exercise with IMPASS					
HE Naval Gun Shell, 5-inch	8	1	244	170	109
Bombing Exercise					
MK-20	109.7	3.3	660	460	296
MK-82	192.2	3.3	772	539	346
MK-83	415.8	3.3	959	668	430
MK-84	945	3.3	1,206	841	541

AMNS: airborne mine neutralization system; ft.: foot/feet; HE: high-explosive; IMPASS: integrated marine portable acoustic scoring system; NEW: net explosive weight; lb.: pound; oz.: ounce, UNDET: underwater detonation; %: percent

Fish not killed or driven from a location by an explosion might change their behavior, feeding pattern, or distribution. Changes in behavior of fish have been observed as a result of sound produced by explosives, with effect intensified in areas of hard substrate (Wright 1982). Stunning from pressure waves could also temporarily immobilize fish, making them more susceptible to predation.

The number of fish killed by an underwater explosion would depend on the population density in the vicinity of the blast, as well as factors discussed above such as net explosive weight, depth of the explosion, and fish size. For example, if an explosion occurred in the middle of a dense school of menhaden, herring, or other schooling fish, a large number of fish could be killed. Furthermore, the probability of this occurring is low based on the patchy distribution of dense schooling fish.

A detailed description of weapons firing, launch, and impact noise is provided in Section 3.0.5.3.1.5 (Weapons Firing, Launch, and Impact Noise). Noise under the muzzle blast of a 5-inch gun and directly under the flight path of the shell (assuming the shell is a few meters above the water's surface) would produce a peak sound pressure level of approximately 200 dB re 1 µPa near the surface of the water (1–2 m depth). Sound due to missile and target launches is typically at a maximum during initiation of the booster rocket and rapidly fades as the missile or target travels downrange. Many missiles and targets are launched from aircraft, which would produce minimal noise in the water due to the altitude of the aircraft at launch. Large-caliber non-explosive projectiles, non-explosive bombs, and intact missiles and targets could produce a large impulse upon impact with the water surface (McLennan 1997). These sounds from weapons firing launch, and impact noise would be transient and of short duration, lasting no more than a few seconds at any given location.

See the discussion in Section 3.0.5.3.1.4 (Swimmer Defense Airguns) for details on swimmer defense airguns. Source levels are estimated to be 185-195 dB re 1 μPa^2-s at 1 m. For 100 shots, the cumulative sound exposure level would be approximately 215-225 dB re 1 μPa^2-s at 1 m.

Details pertaining to the proposed pile driving activities, and potential resultant noise levels are discussed in Section 3.0.5.3.1.3 (Pile Driving). Impulses from the impact pile driving hammer are broadband and carry most of their energy in the lower frequencies. The impulses can produce a shock wave that is transmitted to the sediment and water column (Reinhall and Dahl 2011). Elevated causeway system pile installation and removal within the project area would result in a temporary increased in underwater noise levels.

3.9.3.1.3.1 No Action Alternative – Training Activities

Training activities under the No Action Alternative do not include the use of pile driving or swimmer defense airguns.

As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.8-1, and Section 3.0.5.3.1.2 (Explosives), training activities under the No Action Alternative would use underwater detonations and explosive munitions. Training activities involving explosions would be conducted throughout the Study Area but would be concentrated in the VACAPES Range Complex, followed in descending order of numbers of activities by JAX, Navy Cherry Point, GOMEX, and the Northeast Range Complexes. These events would be concentrated in the Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf or the Gulf Stream Open Ocean Area, with lesser activities in the Gulf of Mexico Large Marine Ecosystem and the North Atlantic Gyre Open Ocean Areas. Training activities that involve underwater detonations and explosive munitions typically occur greater than 3 nm from shore.

Sounds from explosions could cause hearing loss in nearby fish (dependent upon charge size). Permanent hearing loss has not been demonstrated in fish, as lost sensory hair cells can be replaced unlike in mammals. Fish that experience hearing loss could miss opportunities to detect predators or prey, or reduce interspecific communication. If an individual fish were repeatedly exposed to sounds from underwater explosions that caused alterations in natural behavioral patterns or physiological stress, these impacts could lead to long-term consequences for the individual such as reduced survival, growth, or reproductive capacity. However, the time scale of individual explosions is very limited, and training exercises involving explosions are dispersed in space and time. Consequently, repeated exposure of individual fish to sounds from underwater explosions is not likely and most acoustic effects are expected to be short-term and localized. Long-term consequences for populations would not be expected.

As described in Chapter 2 (Description of Proposed Action and Alternatives), and Table 2.8-1, training activities under the No Action Alternative include activities that produce in water noise from weapons firing, launch, and non-explosive practice munitions impact with the water's surface. Activities are spread throughout the Study Area but would be concentrated in VACAPES, Navy Cherry Point, and JAX Range Complexes, with lesser numbers of events in the GOMEX and Northeast Range Complexes. These activities could take place within any large marine ecosystem or open ocean area, but would be concentrated within the Southeast U.S. Continental Shelf, Northeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems and the Gulf Stream Open Ocean Area. Most activities involving large-caliber naval gunfire or the launching of targets, missiles, bombs, or other ordnance are conducted greater than 12 nm from shore.

Fish that are exposed to noise from weapons firing, launch, and non-explosive practice munitions impact with the water's surface may exhibit brief behavioral reactions; however, due to the short term, transient nature of weapons firing, launch, and non-explosive impact noise, animals are unlikely to be exposed multiple times within a short period. Behavioral reactions would likely be short-term (minutes) and substantive costs or long-term consequences for individuals or populations would not be expected.

Atlantic Salmon (Endangered Species Act-Listed)

Atlantic salmon, as summarized in Section 3.9.2.3 (Atlantic salmon [*Salmo salar*]), are anadromous and spend a portion of their lives in both the marine environment as well as in the riverine and estuarine systems of the northeast United States and Canada. While in the marine environment, Atlantic salmon have the potential to be exposed to explosive energy and sound as its being used in the Northeast Range Complexes. Since salmon spawn in rivers and the early life stages of the fish occur in riverine and estuarine environments, eggs and larvae would not be exposed to impulsive sounds produced from explosions, weapons firing, launch, and non-explosive practice munitions impact with the water's surface during training events.

Training activities involving explosives in the Northeast Range Complexes have the possibility to impact Atlantic salmon, potentially resulting in short-term behavioral or physiological responses, hearing loss, injury, or mortality. Atlantic salmon typically travel in schools within the top 10 ft. (3 m) of the water column (Hedger et al. 2009) and would, therefore, be susceptible to explosions both at the surface and at depth. However, given the infrequent nature of training events involving explosives in the Northeast Range Complexes and the rarity of the species, the likelihood of a school of salmon encountering an explosive event taking place anywhere within the range complexes is remote.

There is also a potential for Atlantic salmon to encounter training activities that produce in water noise from weapons firing, launch, and non-explosive practice munitions impact with the water's surface within the Northeast Range Complexes. However, the likelihood of encounter, based on the rarity of the species and the relative infrequency of events, is very unlikely. Salmon that are exposed to noise from weapons firing, launch, and non-explosive practice munitions impact with the water's surface may exhibit brief behavioral reactions. However, due to the short-term, transient nature of these activities, animals are unlikely to be exposed multiple times within a short period. Behavioral reactions would likely be short term (minutes) and substantive costs or long-term consequences for individuals or populations would not be expected.

The designated primary constituent elements (sites for spawning and incubation, sites for juvenile rearing, and sites for migration) for Atlantic salmon critical habitat do not occur within the Study Area and therefore, the proposed training activities would not affect the critical habitat.

Largetooth Sawfish (Endangered Species Act-Listed)

The historical range of the largetooth sawfish in the waters of the U.S. originally included the shallow waters of the entire Gulf of Mexico, as reviewed in Section 3.9.2.4 (Largetooth Sawfish [*Pristis pristis*]). However, confirmed sightings of these fish have not occurred in U.S. waters since 1961 (FR 74 (144): 37671-37674, July 29, 2009).

Due to their preference for shallow, nearshore waters (less than 33 ft. [10 m]) (FR 74 (144): 37671-37674, July 29, 2009), it is unlikely that largetooth sawfish would encounter any training activities involving explosives in the GOMEX Range Complex. If an encounter were to occur, it may result in behavior responses, hearing loss, physical injury, or death to fish near the activity.

There is also a small potential for largetooth sawfish to encounter training activities that produce in-water noise from weapons firing, launch, and non-explosive practice munitions impact with the water's surface within the GOMEX Range Complex where these activities occur. However, due to the largetooth sawfish's preference for nearshore, shallow waters, it is unlikely these fish would occur in waters where training was occurring. Were they to co-occur, the noise from weapons firing, launch, and non-explosive practice munitions impact with the water's surface would be unlikely to disturb the fish due to the largetooth sawfish's preference for moving along the seafloor. Behavioral reactions would likely be short term (minutes) and substantive costs or long-term consequences for individuals or populations would not be expected.

As noted, due to the overall lack of any confirmed largetooth sawfish sightings in U.S. waters over the last five decades, it is highly unlikely that largetooth sawfish will co-occur with any Navy training activities, particularly given the infrequent nature of these events.

Smalltooth Sawfish (Endangered Species Act-Listed)

The distribution of the smalltooth sawfish has contracted greatly over the past several decades and is believed to be restricted now primarily to Florida waters (Simpfendorfer 2006; Simpfendorfer and Wiley 2006), as described in Section 3.9.2.5 (Smalltooth Sawfish [*Pristis pectinata*]). However, verified encounters over the past 15 years have been noted within the Panama City OPAREA and the Key West Range Complex in the Gulf of Mexico and in the JAX Range Complex along the east coast of the United States (Simpfendorfer and Wiley 2006). Typically, smalltooth sawfish prefer nearshore, coastal habitats, but it is not uncommon for larger adults to occur in deeper waters ranging from 230 to 400 ft. (70 to 120 m) in depth (Poulakis and Seitz 2004; Simpfendorfer 2006).

While unlikely, due to their preference for shallow, nearshore habitats, smalltooth sawfish may occur in areas that coincide with training activities involving explosives, such as the JAX Range Complexes and the Panama City OPAREA. Encounters may result in behavior responses, hearing loss, physical injury, or death to fish near the activity.

Smalltooth sawfish could be exposed to training activities that produce in-water noise from weapons firing, launch, and non-explosive practice munitions impact with the water's surface. These encounters were they to occur, have the potential to expose smalltooth sawfish to noise, potentially resulting in short-term behavioral responses. Behavioral reactions would likely be short term (minutes) and substantive costs or long-term consequences for individuals or populations would not be expected.

As discussed in Section 3.9.2.5 (Smalltooth Sawfish [*Pristis pectinata*]), the Key West Range Complex does not overlap with critical habitat areas; the northeastern boundary (W-174G) of the Key West Range Complex is within approximately 9 nm [17 km] of critical habitat at its closest point. Therefore, proposed training activities are unlikely to take place within smalltooth sawfish critical habitat, although sound from activities involving impulsive sound sources that take place near the Key West Range Complex boundary may be present within the critical habitat. The primary constituent elements (i.e., red mangroves and shallow water less than 3 ft. [0.9 m] deep) would not be affected.

Shortnose Sturgeon (Endangered Species Act-Listed)

As discussed in Section 3.9.2.6 (Shortnose Sturgeon [*Acipenser brevirostrum*]), shortnose sturgeon, which primarily inhabit rivers and estuaries, are not expected to occur in portions of the Study Area located in the Atlantic Ocean (Dadswell 2006; National Marine Fisheries Service 1998). Individuals generally remain within their natal river or estuary, only occasionally moving to marine environments (Dadswell et al. 1984). In addition, shortnose sturgeon rarely occur in the lower Chesapeake Bay portion of the Study Area. The current Chesapeake Bay system population appears to be centered in the upper Chesapeake Bay (Welsh et al. 2002). However, the species is known to frequent other inshore portions of the Study Area, including the Kennebec River in Maine, Kings Bay in Georgia, and St. Johns River in Florida.

Underwater explosions, particularly those associated with mine warfare training that occur in shallow water areas of the JAX Range Complex or activities in the shallow waters of the Northeast Range Complexes, may impact shortnose sturgeon. Encounters may result in behavioral responses, hearing loss, physical injury, or death to fish if near the activity.

Since shortnose sturgeon rarely move far offshore, exposure to training activities that produce in water noise from weapons firing, launch, and non-explosive practice munitions impact with the water's surface would be unlikely as well. These encounters were they to occur, have the potential to expose shortnose sturgeon to sound and general disturbance, potentially resulting in short-term behavioral responses. Behavioral reactions would likely be short-term (minutes) and substantive costs or long-term consequences for individuals or populations would not be expected.

Gulf Sturgeon (Endangered Species Act-Listed)

As discussed in Section 3.9.2.7 (Gulf Sturgeon [*Acipenser oxyrinchus desotoi*]), Gulf sturgeon, when not spawning in the rivers, are found in the Gulf of Mexico in nearshore and inshore waters. They typically range in distribution from Louisiana through the panhandle of Florida (U.S. Fish and Wildlife Service and National Marine Fisheries Service 2009).

Due to their preference for shallow, nearshore waters (less than 20 ft. [6 m]) (Fox et al. 2000; Fox et al. 2002), it is unlikely that Gulf sturgeon would occur in areas that coincide with training activities involving explosives in the GOMEX Range Complex. Encounters, if they were to occur, may result in behavioral responses, hearing loss, physical injury, or death to fish near the activity.

There is a potential for Gulf sturgeon to encounter training activities that produce in-water noise from weapons firing, launch, and non-explosive practice munitions impact with the water's surface within the GOMEX Range Complex where these activities occur. Due to the short-term, transient nature of these activities, animals are unlikely to be exposed multiple times within a short period. Behavioral reactions would likely be short-term (minutes) and substantive costs or long-term consequences for individuals or populations would not be expected. In addition, due to the sturgeon's preference for nearshore, shallow waters, it is unlikely these fish would occur in waters in which the training was occurring.

Proposed training activities overlap designated critical habitat for Gulf sturgeon within one mile of the coastline in the eastern Gulf of Mexico as discussed in Section 3.9.2.7.1 (Status and Management). Most of the primary constituent elements are generally not applicable to the Study Area since they occur within the riverine habitat of the species. The use of explosive and other impulsive sources in Gulf sturgeon critical habitat are unlikely to interfere with the individuals' safe and unobstructed passage between riverine, estuarine, and marine habitats. However, part of the primary constituent elements for Gulf sturgeon critical habitat includes abundant prey items (e.g., amphipods, lancelets, polychaetes, gastropods, ghost shrimp, isopods, molluscs, and crustaceans) within estuarine and marine habitats and substrates. It is possible that the use of explosive sound sources within the critical habitat may impact the abundance of prey items within the vicinity of the sound source. Therefore, explosive sound sources used in proposed training activities may affect Gulf sturgeon designated critical habitat.

<u>Atlantic Sturgeon (Endangered Species Act-Listed)</u>

As discussed in Section 3.9.2.8 (Atlantic Sturgeon [*Acipenser oxyrinchus oxyrinchus*]), Atlantic sturgeon, when not in the rivers during spawning season, inhabit estuarine and marine waters of the Atlantic coast out to a depth of 164 ft. (50 m) (Bain 1997). Atlantic sturgeon are found along nearly the entire east coast of the United States from the St. Croix River in Maine south to the St. Johns River in Florida.

Atlantic sturgeon may occur in areas that coincide with training activities involving explosives, particularly in the Northeast, VACAPES, Navy Cherry Point, and JAX Range Complexes. Atlantic sturgeon frequent the waters of the continental shelf and migrate up and down the coastline. Underwater explosions, particularly those associated with mine warfare training that occur in shallow water areas close to shore, may coincide with areas sturgeon frequent. Encounters may result in behavioral responses, hearing loss, physical injury, or death to fish near the activity.

There is also a potential for Atlantic sturgeon to encounter training activities that produce in-water noise from weapons firing, launch, and non-explosive practice munitions impact with the water's surface within any of the Atlantic range complexes where these activities occur. Sturgeon exposed to noise from weapons firing, launch, and non-explosive practice munitions impact with the water's surface may exhibit brief behavioral reactions. However, due to the short-term, transient nature of these activities, animals are unlikely to be exposed multiple times within a short period. Behavioral reactions would likely be short-term (minutes) and substantive costs or long-term consequences for individuals or populations would not be expected.

Conclusion

Impacts to fish due to explosives and other impulsive sound are expected to be limited to short-term, minor behavioral reactions. However, long-term consequences for populations would not be expected.

Pursuant to the ESA, the use of explosives during training activities as described under the No Action Alternative:

- *may affect and is likely to adversely affect the ESA-listed Atlantic sturgeon, Gulf sturgeon, and smalltooth sawfish;*
- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, shortnose sturgeon, and largetooth sawfish;*
- *will have no effect on designated critical habitat for Atlantic salmon and smalltooth sawfish; and*
- *may affect but is not likely to adversely affect designated Gulf sturgeon critical habitat.*

Pursuant to the ESA, weapons firing, launch, and impact noise during training activities as described under the No Action Alternative:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Gulf sturgeon, and Atlantic sturgeon;*
- *will have no effect on designated critical habitat for Atlantic salmon, smalltooth sawfish, and Gulf sturgeon.*

3.9.3.1.3.2 No Action Alternative – Testing Activities

Testing Activities do not include pile driving.

As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.8-2 and Table 2.8-3, and Section 3.0.5.3.1.2 (Explosives), testing activities under the No Action Alternative would involve underwater detonations and explosive practice munitions. Testing activities involving explosions could be conducted throughout the Study Area but would be concentrated in the VACAPES Range Complex, followed by the JAX Range Complex. These events would be concentrated in the Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf Large Marine Ecosystems and the Gulf Stream Open Ocean Area. Testing activities using explosions do not normally occur within 3 nm of shore; the exception is the designated underwater detonation area near Naval Surface Warfare Center, Panama City Division Testing Range, which is located nearshore, partially within the surf zone. Proposed testing activities under the No Action Alternative that involve explosives and other impulsive sources differ in number and location from training activities under the No Action Alternative; however, the types and severity of impacts would not be discernible from those described above in Section 3.9.3.1.3.1 (No Action Alternative – Training Activities).

As described in Tables 2.8-2 to 2.8-3, testing activities under the No Action Alternative include activities that produce in water noise from weapons firing, launch, and non-explosive practice munitions impact with the water's surface. Activities are spread throughout the Study Area but would be concentrated in the GOMEX and Northeast Range Complexes. These activities could take place within any large marine ecosystem or open ocean area, but would be concentrated within the Northeast U.S. Continental Shelf and Gulf of Mexico Large Marine Ecosystems and the Gulf Stream Open Ocean Area. Proposed testing activities under the No Action Alternative that produce in-water noise from weapons firing, launch, and non-explosive practice munitions impact with the water's surface differ in number and location from training activities under the No Action Alternative; however, the types and severity of impacts would not be discernible from those described above in Section 3.9.3.1.3.1 (No Action Alternative – Training Activities).

Testing activities under the No Action Alternative would include the use of swimmer defense airguns up to five times per year pierside at Joint Expeditionary Base Little Creek in Virginia Beach, Virginia and up to five times per year pierside at Newport, Rhode Island as described in Table 2.8-3. Both of these areas are located within the inland waters of the Northeast U.S. Continental Shelf Large Marine Ecosystem and the Gulf Stream Open Ocean Area.

Single, small airguns (60 cubic inches [983 cubic centimeters]) are unlikely to cause direct trauma to marine fish. Impulses from airguns lack the strong shock wave and rapid pressure increase, as would be expected from explosive sources that can cause primary blast injury or barotrauma. As discussed in Section 3.9.3.1.1.1 (Direct Injury), there is little evidence that airguns can cause direct injury to adult fish, with the possible exception of injuring small juvenile or larval fish nearby (approximately 5 m [16 ft.]). Therefore, larval and small juvenile fish within a few meters of the airgun may be injured or killed. Considering the small footprint of this hypothesized injury zone, and the isolated and infrequent use of the swimmer defense airgun, population consequences would not be expected.

As discussed in Section 3.9.3.1.1.2 (Hearing Loss), temporary hearing loss in fish could occur if fish were exposed to impulses from swimmer defense airguns, although some studies show no hearing loss from exposure to airguns within 5 m (16 ft.). Therefore, fish within a few meters of the airgun may receive temporary hearing loss. However, due to the relatively small size of the airgun, and their limited use in pierside areas, impacts would be minor, and may only impact a few individual fish. Population consequences would not be expected.

Airguns do produce broadband sounds; however, the duration of an individual impulse is about 1/10th of a second. Airguns could be fired up to 100 times per event, but would generally be used less based on the actual testing requirements. The pierside areas where these activities are proposed are inshore, with high levels of use, and therefore have high levels of ambient noise, see Section 3.0.4.5 (Ambient Noise). Auditory masking is discussed in Section 3.9.3.1.1.3 (Auditory Masking), and only occurs when the interfering signal is present. Due to the limited duration of individual shots and the limited number of shots proposed for the swimmer defense airgun, only brief, isolated auditory masking to marine fish would be expected. Population consequences would not be expected.

In addition, fish that are able to detect the airgun impulses may exhibit alterations in natural behavior. As discussed in Section 3.9.3.1.1.4 (Physiological Stress and Behavioral Reactions), some fish species with site fidelity such as reef fish may show initial startle reactions, returning to normal behavioral patterns within a matter of a few minutes. Pelagic and schooling fish that typically show less site fidelity may avoid the immediate area for the duration of the events. Due to the limited use and relatively small footprint of swimmer defense airguns, impacts to fish are expected to be minor. Population consequences would not be expected.

Impacts to fish due to exposure to impulsive sound and especially explosive energy could be injured, killed, suffer hearing loss, or alter natural behavior patterns. However, long-term consequences for populations would not be expected.

Underwater explosions, particularly those associated with mine warfare testing that occur in shallow water areas of the Naval Surface Warfare Center, Panama City Division Testing Range, may coincide with areas Gulf sturgeon and smalltooth sawfish frequent. Exposures may result in behavioral responses, hearing loss, physical injury, or death to fish near the activities. The remainder of predicted impacts to ESA-listed fish species and any designated critical habitat would not be discernible from those described above in Section 3.9.3.1.2.1 (No Action Alternative – Training Activities).

Pursuant to the ESA, the use of explosives during testing activities as described under the No Action Alternative:

- *may affect and is likely to adversely affect the ESA-listed Atlantic sturgeon, Gulf sturgeon, and smalltooth sawfish;*
- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, and shortnose sturgeon;*
- *will have no effect on designated critical habitat for Atlantic salmon and smalltooth sawfish; and*
- *may affect but is not likely to adversely affect designated Gulf sturgeon critical habitat.*

Pursuant to the ESA, the use of airguns and weapons firing, launch, and impact noise during testing activities as described under the No Action Alternative:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Gulf sturgeon, and Atlantic sturgeon; and*
- *will have no effect on designated critical habitat for Atlantic salmon, smalltooth sawfish and Gulf sturgeon.*

3.9.3.1.3.3 Alternative 1- Training Activities

As described in Chapter 2 (Description of Proposed Action and Alternatives), Table 2.8-1, and Section 3.0.5.3.1.2 (Explosives), the number of annual training activities that use explosives under Alternative 1 would increase. These activities would happen in the same general locations as described by the No Action Alternative including the following notable exceptions:

- Training activities using explosive source sonobuoys (Bin E4) would be relocated from the GOMEX Range Complex under Alternative 1 to the VACAPES and JAX Range Complexes and increase. This would lead to a decrease of potential impacts to fish in the GOMEX Range Complex, and an increase in potential impacts for the VACAPES and JAX Range Complexes.
- Alternative 1 would include the training activity civilian port defense, which is not included under the No Action Alternative. This event would take place once every two years in one of the following locations: Earle, New Jersey; Groton, Connecticut; Hampton Roads, Virginia; Morehead City, North Carolina; Wilmington, North Carolina; Kings Bay, Georgia; Mayport, Florida; Beaumont, Texas; or Corpus Christi, Texas. However, any phases of the event that involve underwater detonation training would occur in designated areas in the VACAPES, JAX, and GOMEX Range Complexes.
- Two additional join task force/sustainment exercises per year (four total) are proposed under Alternative 1.
- Mine neutralization events would increase in the VACAPES Range Complex under Alternative 1 to 524 events per year from 24 events per year as described under the No Action Alternative. These activities use up to a 60 lb. net explosive weight charge (but typically use a 20 lb. net explosive weight charge or less) to destroy an underwater mine (explosive mines are not used for this activity, only mine-like shapes).

Proposed training activities under Alternative 1 that involve underwater explosions differ in number from training activities proposed under the No Action Alternative; however, the locations, types, and severity of impacts would not be discernible from those described above in Section 3.9.3.1.3.1 (No Action Alternative – Training Activities).

As described in 3.0.5.3.1.5. (Weapons Firing, Launch, and Impact Noise), training activities under Alternative 1 include activities that produce in-water noise from weapons firing, launch, and non-explosive practice munitions impact with the water's surface. Activities are spread throughout the Study Area but would be concentrated in VACAPES, Navy Cherry Point, and JAX Range Complexes, with lesser numbers of events in the GOMEX and Northeast Range Complexes. These activities could take place within any large marine ecosystem or open ocean area, but would be concentrated within the Northeast U.S. Continental Shelf, Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems and the Gulf Stream Open Ocean Area. Proposed training activities under Alternative 1 that produce in water noise from weapons firing, launch, and non-explosive practice munitions impact with the water's surface differ in number from training activities proposed under the No Action Alternative. The associated impacts would differ in quantity; however, the locations, types, and severity of impacts would not be discernible from those described above in Section 3.9.3.1.3.1 (No Action Alternative – Training Activities).

Training activities under Alternative 1 do not include the use of swimmer defense airguns.

As described in Table 2.8-1 and Section 3.0.5.3.1.3 (Pile Driving), training activities under Alternative 1 include pile driving associated with construction and removal the elevated causeway system. This activity would take place nearshore and within the surf zone, once per year at either Marine Corps Base Camp Lejeune, North Carolina; Joint Expeditionary Base Fort Story, Virginia; or Joint Expeditionary Base Little Creek, Virginia. The two areas in Virginia are located within the Northeast U.S. Continental Shelf Large Marine Ecosystem, and the area in North Carolina is located within the Southeast U.S. Continental Shelf Large Marine Ecosystem. The pile driving locations are adjacent to Navy pierside locations in industrialized waterways that carry a high volume of vessel traffic in addition to Navy vessels using the pier. These coastal areas tend to have high ambient noise levels due to natural and anthropogenic sources and have limited numbers of sensitive fish species present. Underwater sound pressure levels from impact pile driving would be approximately 194 dB re 1 µPa, and a peak sound pressure level of 207 dB re 1 µPa at 10 m (33 ft.). This corresponds to a single strike sound exposure level of approximately 180 dB re 1 μPa^2-s at 10 m (33 ft.), based on a comparison sound exposure level versus sound pressure level for other pile driving measurements (California Department of Transportation 2009). Conservatively assuming eight piles a day are driven at 10 minutes per pile and 50 strikes per minute, cumulative sound exposure levels would be approximately 216 dB re 1 μPa^2-s at 10 m (33 ft.). Underwater sound levels likely to result from vibratory pile driving would be a sound pressure level of 170 dB re 1 µPa at 10 m (33 ft.).

As discussed in Section 3.9.3.1.1.1 (Direct Injury), injuries and mortality to fish are possible near the pile driving location. Based on the above sound levels for pile driving, fish within about 10 m (33 ft.) of the active impact pile driving operation could suffer injuries with the probability and severity of injuries increasing closer to the pile.

As discussed in Section 3.9.3.1.1.2 (Hearing Loss), hearing loss in fish is possible within the vicinity of a pile driving event. Hearing loss due to pile driving in fish has not been studied; however, other impulsive sounds such as airgun shots have been studied and can be applied in this case. Based on the limited research, fish within a few tens of meters of the active pile driving activity may suffer temporary hearing loss.

As discussed in Section 3.9.3.1.1.3 (Auditory Masking), auditory masking could occur due to anthropogenic noise interfering with biologically relevant sounds. Pile driving may cause auditory masking on the order of a kilometer or more; however, pile driving activities are intermittent, with actual pile driving occurring for only about 80 minutes per 24-hour period. Therefore, auditory masking would be localized and of limited duration during pile driving.

As discussed in Section 3.9.3.1.1.4 (Physiological Stress and Behavioral Responses), fish may have behavioral reactions to pile driving sound. Based on the predicted pile driving noise levels and the limited research on fish reaction to pile driving, fish within approximately one kilometer may react to pile driving noise by increasing their swimming speed, moving away from the source, or not responding at all. Fish may habituate, or choose to tolerate pile driving noise after multiple strikes, returning to normal behavior patterns during the pile driving activities.

Overall, impacts to fish from pile driving are expected to be intermittent and isolated with only a single two to three week period of active pile driving per year at one location in the nearshore waters near Virginia Beach, Virginia, or Camp Lejeune, North Carolina. Long term consequences for fish populations would not be expected.

Potential effects of training activities involving impulsive sounds under the Alternative 1 on ESA-listed fish species would be similar to those described above for training activities under the No Action Alternative. In addition, pile driving activities occurring at Marine Corps Base Camp Lejeune, Joint Expeditionary Base Fort Story, and Joint Expeditionary Base Little Creek (discussed above) may impact Atlantic sturgeon, which are found in all of these locations. While also found on the east coast of the United States, shortnose sturgeon are rarely observed in waters between the northern Chesapeake Bay and the Cape Fear River in North Carolina (National Marine Fisheries Service 1998) and would, therefore, not likely be exposed to pile driving activities. Shortnose sturgeon that happen to be in the vicinity of pile driving activities may suffer behavioral impacts or temporary hearing loss depending on their proximity to the activity.

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 1:

- *may affect and is likely to adversely affect the ESA-listed Gulf sturgeon, Atlantic sturgeon, and smalltooth sawfish;*
- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, and shortnose sturgeon;*
- *will have no effect on designated critical habitat for Atlantic salmon and smalltooth sawfish; and*
- *may affect but is not likely to adversely affect designated Gulf sturgeon critical habitat.*

Pursuant to the ESA, pile driving and weapons firing, launch, and impact noise during training activities as described under Alternative 1:

- *may affect but are not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Gulf sturgeon, and Atlantic sturgeon; and*
- *will have no effect on designated critical habitat for Atlantic salmon, smalltooth sawfish and Gulf sturgeon.*

3.9.3.1.3.4 Alternative 1 – Testing Activities

As described in Chapter 2 (Description of Proposed Action and Alternatives), Tables 2.8-2 to 2.8-3, and in Section 3.0.5.3.1.2 (Explosives), the number of annual testing activities that use explosives under Alternative 1 would increase compared to the No Action Alternative. These activities would happen in the same general locations under Alternative 1 as under the No Action Alternative. New testing activities proposed under Alternative 1 and notable increases in numbers of activities from the No Action Alternative are as follows:

- Alternative 1 would include one aircraft carrier sea trial that would take place once within a five-year period.
- Alternative 1 would include one aircraft carrier ship shock trial during the five-year period. This event could take place in one of two locations (VACAPES or JAX Range Complex) during fall, winter or summer. The aircraft carrier ship shock trial would use up to four 58,000 lb. net explosive weight charges, one at a time, over a several week period.
- Alternative 1 would include one guided missile destroyer ship shock trial and two Littoral Combat Ship shock trials during the five-year period. These ship shock trials would use up to four 14,500 lb. net explosive weight charges, one at a time, over a several week period. These events could take place in the JAX Range Complex during fall, spring, or summer, or year-round within the VACAPES Range Complex.

As described in Tables 2.8-2 and 2.8-3, testing activities under the Alternative 1 include activities that produce in-water noise from weapons firing, launch, and non-explosive practice munitions impact with the water's surface. Activities are spread throughout the Study Area but would be concentrated in the GOMEX and Northeast Range Complexes. These activities could take place within any large marine ecosystem or open ocean area, but would be concentrated within the Northeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems, and the Gulf Stream Open Ocean Area. Proposed testing activities under Alternative 1 that involve underwater explosions differ in number and location from testing activities proposed under the No Action Alternative; however, the types, and severity of impacts would not be discernible from those described above in Section 3.9.3.1.3.2 (No Action Alternative – Testing Activities).

As described in Table 2.8-3, testing activities under Alternative 1 would include the use of swimmer defense airguns at Joint Expeditionary Base Little Creek, Virginia up to two times per year, and pierside at Newport, Rhode Island up to five times per year. Both of these areas are located within the inland waters of the Northeast U.S. Continental Shelf Large Marine Ecosystem. Stationary source testing at Naval Surface Warfare Center, Panama City Division Testing Range includes a limited amount of swimmer defense airgun use and could occur up to 10 times per year. This area is located in inland waters, within the Gulf of Mexico Large Marine Ecosystem. The proposed pierside swimmer defense activities under Alternative 1 represent a decrease of three events per year as compared to the No Action Alternative. Therefore, the associated impacts would differ in quantity, but the types and severity of impacts would not be discernible from those discussed above in Section 3.9.3.1.3.2 (No Action Alternative – Testing Activities).

Potential effects of testing activities involving impulsive sounds under Alternative 1 on ESA-listed fish species would be similar to those described above for testing activities under the No Action Alternative in Section 3.9.3.1.3.2 0 (No Action Alternative – Testing Activities). In addition, the testing of swimmer defense airguns at pierside locations at Naval Surface Warfare Center, Panama City Division Testing Range may potentially impact the largetooth sawfish, smalltooth sawfish, and the Gulf sturgeon. As discussed above, fish exposed to airguns could receive temporary hearing loss or exhibit an alteration in natural behavior. Neither of these conditions should have a lasting effect nor be expected to compromise the general health or condition of individual fish. Population consequences would not be expected.

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 1:

- *may affect and is likely to adversely affect the ESA-listed Atlantic sturgeon. Gulf sturgeon, and smalltooth sawfish;*
- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, and shortnose sturgeon;*
- *will have no effect on designated critical habitat for Atlantic salmon and smalltooth sawfish; and*
- *may affect but is not likely to adversely affect designated Gulf sturgeon critical habitat.*

Pursuant to the ESA, the use of airguns and weapons firing, launch, and impact noise during testing activities as described under Alternative 1:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Gulf sturgeon, and Atlantic sturgeon; and*
- *will have no effect on designated critical habitat for Atlantic salmon, smalltooth sawfish and Gulf sturgeon.*

3.9.3.1.3.5 Alternative 2 – Training Activities (Preferred Alternative)

Proposed training activities under Alternative 2 are identical to training activities proposed under Alternative 1. Therefore, the predicted impacts for Alternative 2 are identical to those described above in Training Activities under Section 3.9.3.1.3.3 (Alternative 1- Training Activities).

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 2:

- *may affect and is likely to adversely affect the ESA-listed Gulf sturgeon, Atlantic sturgeon, and smalltooth sawfish;*
- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, and shortnose sturgeon;*
- *will have no effect on designated critical habitat for Atlantic salmon and smalltooth sawfish; and*
- *may affect but is not likely to adversely affect designated Gulf sturgeon critical habitat.*

Pursuant to the ESA, pile driving and weapons firing, launch, and impact noise during training activities as described under Alternative 2:

- *May affect but are not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Gulf sturgeon, and Atlantic sturgeon; and*
- *Will have no effect on designated critical habitat for Atlantic salmon, smalltooth sawfish and Gulf sturgeon.*

3.9.3.1.3.6 Alternative 2 – Testing Activities (Preferred Alternative)

As described in Chapter 2 (Description of Proposed Action and Alternatives), Tables 2.8-2 to 2.8-3, and in Section 3.0.5.3.1.2 (Explosives), the number of annual testing activities that use explosives under Alternative 2 would increase compared to the No Action Alternative. The associated impacts would differ in quantity; however, the locations, types, and severity of impacts would not be discernible from those described above in Section 3.9.3.1.3.2 (No Action Alternative – Testing Activities). Also see Section 3.9.3.1.3.4 (Alternative 1 – Testing Activities) for a discussion of additional activities (one aircraft carrier sea trial and four ship shock trials) and the predicted impacts, which are identical under Alternatives 1 and 2.

As described in Tables 2.8-2 and 2.8-3, testing activities under the Alternative 2 include activities that produce in-water noise from weapons firing, launch, and non-explosive practice munitions impact with the water's surface. Activities are spread throughout the Study Area but would be concentrated in the GOMEX and Northeast Range Complexes. These activities could take place within any large marine ecosystem or open ocean area, but would be concentrated within the Northeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems and the Gulf Stream Open Ocean Area. The associated impacts would differ in quantity; however, the locations, types, and severity of impacts would not be discernible from those described above in Section 3.9.3.1.3.2 (No Action Alternative – Testing Activities).

As described in Table 2.8-3, testing activities under Alternative 2 would include the use of swimmer defense airguns at Joint Expeditionary Base Little Creek, Virginia up to three times per year, and pierside at Newport, Rhode Island up to six times per year. Both of these areas are located within the inland waters of the Northeast U.S. Continental Shelf Large Marine Ecosystem. Stationary source testing at Naval Surface Warfare Center, Panama City Division Testing Range includes a limited amount of swimmer defense airgun use and could occur up to 11 times per year. This area is located in inland waters, within the Gulf of Mexico Large Marine Ecosystem. The associated impacts would differ in quantity; however, the locations, types, and severity of impacts would not be discernible from those described above in Section 3.9.3.1.3.2 (No Action Alternative – Testing Activities).

Potential effects of testing activities involving impulsive sounds under Alternative 2 on ESA-listed fish species would be similar to those described above in Section 3.9.3.1.3.4 0 (Alternative 1 – Testing Activities).

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 2:

- *may affect and is likely to adversely affect the ESA-listed Atlantic sturgeon, Gulf sturgeon, and smalltooth sawfish;*
- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, and shortnose sturgeon;*
- *will have no effect on designated critical habitat for Atlantic salmon and smalltooth sawfish; and*
- *may affect but is not likely to adversely affect designated Gulf sturgeon critical habitat.*

Pursuant to the ESA, the use of airguns and weapons firing, launch, and impact noise during testing activities as described under Alternative 2 (Preferred Alternative):

- *may affect is but not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Gulf sturgeon, and Atlantic sturgeon; and*
- *will have no effect on designated critical habitat for Atlantic salmon, smalltooth sawfish and Gulf sturgeon.*

3.9.3.1.3.7 Substressor Impacts on Fishes That Occupy Essential Fish Habitat (Preferred Alternative)

Pursuant to the Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of sonar and other active acoustic sources (Atlantic herring only), explosives, and pile driving during training and testing activities may have minimal and temporary adverse effects on fishes that occupy water column habitat by reducing the quality or quantity of water column (sound and electro-chemical environment) that constitutes Essential Fish Habitat or Habitat Areas of Particular Concern (U.S. Department of the Navy 2013).

3.9.3.2 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) electromagnetic devices, and (2) high energy lasers.

3.9.3.2.1 Impacts from Electromagnetic Devices

Several different electromagnetic devices are used during training and testing activities. A discussion of the type, number, and location of activities using these devices under each alternative is presented in Section 3.0.5.3.2.1 (Electromagnetic Devices).

A comprehensive review of information regarding the sensitivity of marine organisms to electric and magnetic impulses, including fish comprising the subclass Elasmobranchii (sharks, skates, and rays; hereafter referred to as elasmobranchs), as well as other bony fishes, is presented in Normandeau (2011). The synthesis of available data and information contained in this report suggests that while many fish species (particularly elasmobranchs) are sensitive to electromagnetic fields (Hore 2012), further investigation is necessary to understand the physiological response and magnitude of the potential impacts. Most examinations of electromagnetic fields on marine fish have focused on buried undersea cables associated with offshore wind farms in European waters (Boehlert and Gill 2010; Gill 2005; Ohman et al. 2007).

Many fish groups including lamprey, elasmobranchs, sturgeon, eels, marine catfish, salmon, stargazers, and others, have an acute sensitivity to electrical fields, known as electroreception (Bullock et al. 1983; Helfman et al. 2009). Each ESA-listed fish has some level of electroreception, but elasmobranchs (including sawfish) are more sensitive than the others. In elasmobranchs, behavioral and physiological response to electromagnetic stimulus varies by species and age, and appears to be related to foraging behavior (Rigg et al. 2009). Many elasmobranchs respond physiologically to electric fields of 10 nanovolts (nV) per cm and behaviorally at 5 nV per cm (Collin and Whitehead 2004). Electroreceptive marine fish identified above with ampullary (pouch) organs can detect considerably higher frequencies of 50 hertz (Hz) to more than 2 kilohertz (kHz) (Helfman et al. 2009). The distribution of electroreceptors on the head of these fish, especially around the mouth (e.g., along the rostrum of sawfish), suggests that these sensory organs may be used in foraging. Additionally, some researchers hypothesize that the electroreceptors aid in social communication (Collin and Whitehead 2004).

Electromagnetic sensitivities of the Gulf, Atlantic, and shortnose sturgeon have not been studied; however, the presence of electroreceptive ampullae in all sturgeon strongly supports the assertion that they are sensitive to electromagnetic energy. The ampullae of most fish are sensitive to low frequencies (less than 0.1–25 Hz) of electrical energy (Helfman et al. 2009), which may be of physical or biological origin, such as muscle contractions. The ampullae in a closely related species, the shovelnose sturgeon (*Scaphirhynchus platorynchus*), were shown to respond to electromagnetic stimuli in a way comparable to the well-studied elasmobranchs, which are sensitive to electric fields as low as 1 microvolt (µV) per cm with a magnetic field of 100 gauss (G) (Bleckmann and Zelick 2009). Zhang et al. (2012) studied electroreception on Siberian sturgeon (*Acipenser baerii*) and suggested that electroreception plays a role in the feeding behavior of most sturgeon species.

While elasmobranchs and other fish can sense the level of the earth's electromagnetic field, the potential impacts on fish resulting from changes in the strength or orientation of the background field are not well understood. When the electromagnetic field is enhanced or altered, sensitive fish may experience an interruption or disturbance in normal sensory perception. Research on the electrosensitivity of sharks indicates that some species respond to electrical impulses with an apparent avoidance reaction (Helfman et al. 2009; Kalmijn 2000). This avoidance response has been exploited as a shark deterrent, to repel sharks from areas of overlap with human activity (Marcotte and Lowe 2008).

Electroreceptors are thought to aid in navigation, orientation, and migration of sharks and rays (Kalmijn 2000). The exact mechanism is unknown and no magnetic sensory organ has been discovered, but magnetite (a magnetic mineral) is incorporated into the tissues of these fish (Helfman et al. 2009). Magnetite of biogenic origins has been documented in the lateral line of the European eel (*Anguilla anguilla*), a close relative of the American eel (*Anguilla rostrata*); both species occur in the Study Area (Moore and Riley 2009). These species undergo long-distance migrations from natal waters of the Sargasso Sea (North Atlantic Subtropical Gyre) to freshwater habitats in Europe and North America (Helfman et al. 2009), where they mature and then return as adults to the Sargasso Sea to spawn. Some species of salmon, tuna, and stargazers have likewise, been shown to respond to magnetic fields and may also contain magnetite in their tissues (Helfman et al. 2009).

Experiments with electromagnetic pulses can provide indirect evidence of the range of sensitivity of fish to similar stimuli. Two studies reported that exposure to electromagnetic pulses do not have any effect on fish (Hartwell et al. 1991; Nemeth and Hocutt 1990). The observed 48-hour mortality of small estuarine fish (sheepshead minnow, mummichog, Atlantic menhaden, striped bass, Atlantic silverside, fourspine stickleback, and rainwater killifish) exposed to electromagnetic pulses of 100 to 200 kilovolts (kV) per m (10 nanoseconds per pulse) from distances greater than 164 ft. (50 m) was not statistically different than the control group (Hartwell et al. 1991; Nemeth and Hocutt 1990). During a study of Atlantic menhaden, there were no statistical differences in swimming speed and direction (toward or away from the electromagnetic pulse source); between a group of individuals exposed to electromagnetic pulses and the control group (Hartwell et al. 1991; Nemeth and Hocutt 1990).

Both laboratory and field studies confirm that elasmobranchs (and some teleost [bony] fish) are sensitive to electromagnetic fields, but the long-term impacts are not well-known. Electromagnetic sensitivity in some marine fish (e.g., salmonids) is already well-developed at early life stages (Ohman et al. 2007), with sensitivities reported as low as 0.6 millivolt per centimeter (mV/cm) in Atlantic salmon (Formicki et al. 2004); however, most of the limited research that has occurred focuses on adults. Some species appear to be attracted to undersea cables, while others show avoidance (Ohman et al. 2007). Under controlled laboratory conditions, the scalloped hammerhead (*Sphyrna lewini*) and sandbar shark (*Carcharhinus plumbeus*) exhibited altered swimming and feeding behaviors in response to very weak electric fields (less than 1 nV per cm) (Kajiura and Holland 2002). In a test of sensitivity to fixed magnets, five Pacific sharks were shown to react to magnetic field strengths of 25 to 234 G at distances ranging between 0.85 and 1.90 ft. (0.26 and 0.58 m) and avoid the area (Rigg et al. 2009). A field trial in the Florida Keys demonstrated that southern stingray (*Dasyatis americana*) and nurse shark (*Ginglymostoma cirratum*) detected and avoided a fixed magnetic field producing a flux of 950 G (O'Connell et al. 2010). The maximum electromagnetic fields typically generated during Navy training and testing activities is approximately 23 G.

Potential impacts of electromagnetic activity on adult fish may not be relevant to early life stages (eggs, larvae, juveniles) due to ontogenic (life stage-based) shifts in habitat utilization (Botsford et al. 2009; Sabates et al. 2007). Some skates and rays produce egg cases that occur on the bottom, while many neonate and adult sharks occur in the water column or near the water surface. Electromagnetic exposure of eggs and larvae of sensitive bony fish would be low relative to their total ichthyoplankton biomass (Able and Fahay 1998) and; therefore, potential impacts on recruitment would not be expected. Early life history stages of ESA-listed sturgeon and Atlantic salmon occur in freshwater or estuarine habitats outside of the Study Area. Similarly, sawfish neonates and juveniles typically inhabit nearshore mangrove habitats, beyond the areas where electromagnetic devices are used. For many sharks, skates, rays, and livebearers, the fecundity and natural mortality rates are much lower, and the exposure of the larger neonates and juveniles to electromagnetic energy would be similar across life stages for these species.

Based on current literature, only the fish groups identified above are capable of detecting electromagnetic fields (primarily elasmobranchs, sturgeon, salmon, tuna, eels, and stargazers) and thus will be carried forward in this section. The remaining taxonomic groups (from Table 3.9-3) will not be presented further. Aspects of electromagnetic stressors that are applicable to marine organisms in general are described in Section 3.0.5.7.2 (Conceptual Framework for Assessing Effects from Energy-Producing Activities).

3.9.3.2.1.1 No Action Alternative

Training Activities

As indicated in Section 3.0.5.3.2.1 (Electromagnetic Devices), under the No Action Alternative, training activities involving electromagnetic devices occur in the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems as well as Gulf Stream Open Ocean Area—specifically within the VACAPES, Navy Cherry Point, and JAX Range Complexes. Use of electromagnetic devices is concentrated within the

VACAPES Range Complex. Fish species that do not occur within these specified areas, including the ESA-listed Atlantic salmon (Gulf of Maine distinct population segment), largetooth sawfish, and Gulf sturgeon, would not be exposed to electromagnetic devices. Species that do occur within the areas listed above, including the ESA-listed smalltooth sawfish, Atlantic sturgeon, and shortnose sturgeon would have the potential to be exposed to electromagnetic devices.

Exposure of fish is to electromagnetic stressors is limited to those fish groups identified in Section 3.9.2 (Affected Environment), that are able to detect the electromagnetic properties in the water column, such as elasmobranchs, sturgeon, tuna, salmon, eels, and stargazers (Bullock et al. 1983; Helfman et al. 2009). Fish sensitive to electromagnetic fields may experience temporary disturbance of normal sensory perception during migratory or foraging movements, or they could experience avoidance reactions (Kalmijn 2000), resulting in alterations of behavior and avoidance of normal foraging areas or migration routes. Exposure of electromagnetically sensitive fish species to electromagnetic activities has the potential to result in stress to the animal and may also elicit alterations in normal behavior patterns (e.g., swimming, feeding, resting, and spawning). Such effects may have the potential to disrupt long-term growth and survival of an individual. However, due to the temporary (hours) and isolated locations where electromagnetic devices are used in the Study Area, the resulting stress on fish is not likely to impact the health of resident or migratory populations. Likewise, some fish in the vicinity of training activities may react to electromagnetic devices, but the signals are not widespread or frequent enough to alter behavior on a long-term basis. Any behavioral changes are not expected to have lasting effects on the survival, growth, recruitment, or reproduction of these marine fish groups at the population level.

Smalltooth sawfish, Atlantic sturgeon, and shortnose sturgeon are the only ESA-listed fish species occurring in training areas that are known to be capable of detecting electromagnetic energy. Smalltooth sawfish could occur in the JAX Range Complex, but any occurrences would be extremely rare (Florida Museum of Natural History 2011). Atlantic sturgeon and shortnose sturgeon inhabit shallow nearshore and coastal waters, and therefore, may encounter electromagnetic devices used in training activities in the lower Chesapeake Bay. Other locations include portions of the range complexes that lie within the continental shelf, overlapping the normal distribution of Atlantic sturgeon, shortnose sturgeon, and smalltooth sawfish. Any behavioral changes are not expected to have lasting effects on the survival, growth, recruitment, or reproduction of fish at the population level.

All of the primary constituent elements required by Atlantic salmon are applicable to freshwater only and are outside the Study Area. Therefore, none of the electromagnetic stressors would affect Atlantic salmon critical habitat. The primary constituent elements for smalltooth sawfish are red mangrove habitats and shallow marine waters of less than 1 m (3.28 ft.) deep. Electromagnetic activities do not occur at these depths and thus would not overlap with smalltooth sawfish critical habitat.

The electromagnetic devices used in training activities would not cause any risk to fish because of the: (1) relatively low intensity of the magnetic fields generated (0.2 microtesla at 656 ft. [200 m] from the source), (2) highly localized potential impact area, and (3) limited and temporally distinct duration of the activities (hours). Fish may have a detectable response to electromagnetic exposure, but would likely recover completely. Potential impacts of exposure to electromagnetic stressors are not expected to result in substantial changes to 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.

Pursuant to the ESA, the use of electromagnetic devices during training activities as described under the No Action Alternative:

- *will have no effect on ESA-listed Atlantic salmon, largetooth sawfish, or Gulf sturgeon;*
- *may affect but is not likely to adversely affect ESA-listed smalltooth sawfish, Atlantic sturgeon or shortnose sturgeon; and*
- *will have no effect on critical habitat for Atlantic salmon, smalltooth sawfish, or Gulf sturgeon.*

Testing Activities

As indicated in Section 3.0.5.3.2.1 (Electromagnetic Devices), under the No Action Alternative, testing activities involving electromagnetic devices occur in the Northeast U.S. Continental Shelf and Gulf of Mexico Large Marine Ecosystems—specifically within VACAPES Range Complex and Naval Surface Warfare Center, Panama City Division Testing Range. Activities using electromagnetic devices are concentrated within the Naval Surface Warfare Center, Panama City Division Testing Range. Fish species that do not occur within these specified areas—including the ESA-listed Atlantic salmon—would not be exposed to electromagnetic devices. Species that do occur within the areas listed above—including the ESA-listed largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, and Gulf sturgeon—would have the potential to be exposed to electromagnetic devices.

Exposure of fish to electromagnetic stressors is limited to those fish groups identified in Section 3.9.2 (Affected Environment) that are able to detect the electromagnetic properties in the water column, such as elasmobranchs, sturgeon, tuna, salmon, stargazers, and eels (Bullock et al. 1983; Helfman et al. 2009). Two such species, the Atlantic torpedo ray (*Torpedo nobiliana*) and the lesser electric ray (*Narcine brasiliensis*) occur in the Naval Surface Warfare Center, Panama City Division Testing Range, where a portion of the electromagnetic activities will be concentrated. For reasons described in Section 3.9.3.2.1.1 (No Action Alternative) any behavioral changes are not expected to have lasting effects on the survival, growth, recruitment, or reproduction of these marine fish groups at the population level.

With the exception of Atlantic salmon, which do not occur in testing areas under the No Action Alternative, all of the ESA-listed fish species occurring in testing areas are capable of detecting electromagnetic energy. The potential effects to largetooth sawfish are discountable because they are historically rare in the Study Area. The last confirmed records of the species in U.S. waters are from Port Aransas, Texas in 1961; Florida in 1941; and Louisiana in 1917 (FR 76 (133): 40822-40836, July 12, 2011). Smalltooth sawfish are rare in the Gulf of Mexico Large Marine Ecosystem, but since 1999 the species has been documented in the vicinity of the Naval Surface Warfare Center, Panama City Division Testing Range and as far west as Pensacola, Florida (Florida Museum of Natural History 2011). Gulf sturgeon typically inhabit nearshore coastal waters within 1,000 m (3,280 ft.) of the shoreline (Robydek and Nunley 2012), but may also occur as far as 60 nm from shore. Therefore, they may encounter electromagnetic devices during testing activities in the Naval Surface Warfare Center, Panama City Division Testing Range. This area includes nearshore areas and, along with the VACAPES Range Complex may overlap the distribution of Gulf sturgeon, Atlantic sturgeon, and shortnose sturgeon. Therefore, potential exposure to electromagnetic testing activities may also occur in the offshore portions of those areas.

Behavioral changes are not expected to have lasting effects on the survival, growth, recruitment, or reproduction of fish species, see Section 3.9.3.2.1.1 (No Action Alternative). Similarly, electromagnetic devices are not anticipated to affect any primary constituent elements of critical habitat for Atlantic salmon, or smalltooth sawfish (Section 3.9.3.2.1.1, No Action Alternative – Training). The only applicable primary constituent element of critical habitat for Gulf sturgeon is "abundant food items" (e.g., amphipods, polychaetes, gastropods, ghost shrimp, isopods, molluscs, and crustaceans). Electromagnetic devices are not expected to impact these invertebrate populations, as described in Section 3.8 (Marine Invertebrates); therefore, no effects are expected on the abundance of these food items for Gulf sturgeon that contribute to the conservation value of its critical habitat.

The electromagnetic devices used in testing activities would not cause any risk to fish because of the: (1) relatively low intensity of the magnetic fields generated (0.2 microtesla at 656 ft. [200 m] from the source), (2) highly localized potential impact area, and (3) limited and temporally distinct duration of the activities (hours). Fish may have a detectable response to electromagnetic exposure, but would likely recover completely. Potential impacts of exposure to electromagnetic stressors are not expected to result in substantial changes to an individual's behavior, fitness, or species recruitment, and are not expected to result in population-level impacts.

Pursuant to the ESA, the use of electromagnetic devices during testing activities as described under the No Action Alternative:

- *will have no effect on ESA-listed Atlantic salmon;*
- *may affect but is not likely to adversely affect the ESA-listed largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon;*
- *will have no effect on critical habitat for Atlantic salmon, or smalltooth sawfish; and*
- *may affect but is not likely to adversely affect critical habitat for Gulf sturgeon.*

3.9.3.2.1.2 Alternative 1

Training Activities

As indicated in Section 3.0.5.3.2.1 (Electromagnetic Devices), under Alternative 1, electromagnetic device use in the Study Area would increase by less than 2 percent over the No Action Alternative. Training activities involving electromagnetic devices would continue to occur in the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems as well as the Gulf Stream Open Ocean Area—specifically within the VACAPES, Navy Cherry Point, and JAX Range Complexes. In addition, activities would be introduced within the Gulf of Mexico Large Marine Ecosystem—specifically within the GOMEX Range Complex, as well as any of the following bays or inland waters: Sandy Hook Bay, Earle, New Jersey; lower Chesapeake Bay, Hampton Roads, Virginia; Beaufort Inlet Channel, Morehead City, North Carolina; Cape Fear River, Wilmington, North Carolina; St. Andrew Bay, Panama City, Florida; Sabine Lake, Beaumont, Texas; and Corpus Christi Bay, Corpus Christi, Texas. Electromagnetic device activities would remain concentrated within the VACAPES Range Complex. Fish species that do not occur within these specified areas—including the ESA-listed Atlantic salmon—would not be exposed to electromagnetic devices. Species that do occur within the areas listed above—including the ESA-listed largetooth sawfish, smalltooth sawfish, Atlantic sturgeon, shortnose sturgeon, and Gulf sturgeon—would have the potential to be exposed to electromagnetic devices.

Exposure is limited to those marine fish groups able to detect electromagnetic properties as described in Section 3.9.2 (Affected Environment) that are able to detect the electromagnetic properties in the water column, such as elasmobranchs, sturgeon, tuna, salmon, eels, and stargazers (Bullock et al. 1983; Helfman et al. 2009).

As stated in Section 3.9.3.2.1.1 (No Action Alternative), the use of electromagnetic devices is not expected to result in any lasting effects on the survival, growth, recruitment, or reproduction of ESA-listed species. Similarly, the use of electromagnetic devices will not result in impacts on the primary constituent elements of critical habitat for Atlantic salmon or smalltooth sawfish, see Section 3.9.3.2.1.1 (No Action Alternative). The civilian port defense training activity could overlap with Gulf sturgeon critical habitat, if it were to occur in St. Andrew Bay in a given year. Any effects on the primary constituent elements of Gulf sturgeon critical habitat would be discountable because of the low probability of occurrence in any given year, and the food sources identified as primary constituent elements of the critical habitat that occur in St. Andrew Bay would not be impacted by this activity, see Section 3.8 (Marine Invertebrates).

In comparison to the No Action Alternative, the 2 percent increase in activities presented in Alternative 1 would not substantially increase the risk of fish being exposed to electromagnetic energy. The introduction of one civilian port defense training activity in one of the bays listed above could expose estuarine fish, including early life stages of ESA-listed sturgeon and sawfish species to an electromagnetic field and potentially elicit a reaction from sensitive fish, see Section 3.9.3.2.1 (Impacts from Electromagnetic Devices). However, the single occurrence would not likely be widespread or frequent enough to alter behavior on a long-term basis. As described in the No Action Alternative, electromagnetic activities are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of fish species at the population level.

Pursuant to the ESA, the use of electromagnetic devices during training activities as described under Alternative 1:

- *will have no effect on ESA-listed Atlantic salmon;*
- *may affect but is not likely to adversely affect the ESA-listed largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon;*
- *will have no effect on critical habitat for Atlantic salmon or smalltooth sawfish; and*
- *may affect but is not likely to adversely affect critical habitat for Gulf sturgeon.*

Testing Activities

As indicated in Section 3.0.5.3.2.1 (Electromagnetic Devices), under Alternative 1, electromagnetic device use would increase by approximately 14 percent in the Study Area as compared to the No Action Alternative. Testing activities involving electromagnetic devices would continue to occur in the Northeast U.S. Continental Shelf and Gulf of Mexico Large Marine Ecosystems—specifically within the VACAPES Range Complex and the Naval Surface Warfare Center, Panama City Division Testing Range. In addition, activities will be introduced in the Southeast U.S. Continental Shelf Large Marine Ecosystem in the South Florida Ocean Measurement Facility Testing Range, and anywhere within the Gulf of Mexico. Activities involving electromagnetic device use would remain concentrated within the Naval Surface Warfare Center, Panama City Division Testing Range. Fish species that do not occur within these specified areas—including the ESA-listed Atlantic salmon—would not be exposed to electromagnetic devices. Species that do occur within the areas listed above—including the ESA-listed largetooth sawfish, smalltooth sawfish, Atlantic sturgeon, shortnose sturgeon, and Gulf sturgeon—would have the potential to be exposed to electromagnetic devices.

Exposure is limited to those marine fish groups able to detect electromagnetic properties as described in Section 3.9.2 (Affected Environment) that are able to detect the electromagnetic properties in the water column, such as elasmobranchs, sturgeon, tuna, salmon, eels, and stargazers (Bullock et al. 1983; Helfman et al. 2009).

As stated in Section 3.9.3.2.1 (No Action Alternative), the use of electromagnetic devices is not expected to result in any lasting effects on the survival, growth, recruitment, or reproduction of ESA-listed species. Similarly, electromagnetic devices will not result in impacts on the primary constituent elements of critical habitat for Atlantic salmon or smalltooth sawfish (see Section 3.9.3.2.1, No Action Alternative). The electromagnetic activities at Naval Surface Warfare Center, Panama City Division Testing Range could overlap with Gulf sturgeon critical habitat. Any effects on the primary constituent elements of Gulf sturgeon critical habitat would be discountable because the food sources identified as primary constituent elements of the critical habitat that occur in the Naval Surface Warfare Center, Panama City Division Testing Range would not be impacted by this activity (see Section 3.8, Marine Invertebrates).

Electromagnetic activities under Alternative 1 would not increase the likelihood of fish exposure to electromagnetic energy in comparison to the No Action Alternative. Fish may respond to exposure, but these responses are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction at the population level.

Pursuant to the ESA, the use of electromagnetic devices during testing activities as described under Alternative 1:

- *will have no effect on ESA-listed Atlantic salmon;*
- *may affect but is not likely to adversely affect the ESA-listed largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon;*
- *will have no effect on critical habitat for Atlantic salmon or smalltooth sawfish; and*
- *may affect but is not likely to adversely affect critical habitat for Gulf sturgeon.*

3.9.3.2.1.3 Alternative 2 (Preferred Alternative)

Training Activities

The number and location of training activities under Alternative 2 are identical to training activities under Alternative 1. Therefore, impacts and comparisons to the No Action Alternative will also be identical as described in Section 3.9.3.2.1.2 (Alternative 1).

Pursuant to the ESA, the use of electromagnetic devices during training activities as described under Alternative 2:

- *will have no effect on ESA-listed Atlantic salmon;*
- *may affect but is not likely to adversely affect the ESA-listed largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon;*
- *will have no effect on critical habitat for Atlantic salmon or smalltooth sawfish; and*
- *may affect but is not likely to adversely affect critical habitat for Gulf sturgeon.*

Testing Activities

As indicated in Section 3.0.5.3.2.1 (Electromagnetic Devices), under Alternative 2, electromagnetic device use would increase by 35 percent in the Study Area as compared to the No Action Alternative, but only increases by 18 percent as compared to Alternative 1. The location of testing activities and species potentially impacted under Alternative 2 are identical to those specified under Alternative 1.

Fish species that do not occur within these specified areas—including the ESA-listed Atlantic salmon—would not be exposed to electromagnetic devices. Species that do occur within the areas listed above—including the ESA-listed largetooth sawfish, smalltooth sawfish, Atlantic sturgeon, shortnose sturgeon, and Gulf sturgeon—would have the potential to be exposed to electromagnetic devices.

Exposure is limited to those marine fish groups able to detect electromagnetic properties as described in Section 3.9.2 (Affected Environment) that are able to detect the electromagnetic properties in the water column, such as elasmobranchs, sturgeon, tuna, salmon, eels, and stargazers (Bullock et al. 1983; Helfman et al. 2009).

As stated in Section 3.9.3.2.1.1 (No Action Alternative), the use of electromagnetic devices is not expected to result in any lasting effects on the survival, growth, recruitment, or reproduction of ESA-listed species. Similarly, electromagnetic devices would not result in impacts on the primary constituent elements of critical habitat for Atlantic salmon or smalltooth sawfish (see Section 3.9.3.2.1.1, No Action Alternative). The electromagnetic activities at Naval Surface Warfare Center, Panama City Division Testing Range could overlap with Gulf sturgeon critical habitat. Any effects on the primary constituent elements of Gulf sturgeon critical habitat would be discountable because the food sources identified as primary constituent elements of the critical habitat that occur in the Naval Surface Warfare Center, Panama City Division Testing Range would not be impacted by this activity (see Section 3.8, Marine Invertebrates).

Fish may respond to exposure of electromagnetic activities under Alternative 2, but these responses are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction at the population level.

Pursuant to the ESA, the use of electromagnetic devices during testing activities as described under Alternative 2:

- *will have no effect on ESA-listed Atlantic salmon;*
- *may affect but is not likely to adversely affect the ESA-listed largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon;*
- *will have no effect on critical habitat for Atlantic salmon or smalltooth sawfish; and*
- *may affect but is not likely to adversely affect critical habitat for Gulf sturgeon.*

3.9.3.2.1.4 Substressor Impacts on Fishes That Occupy Essential Fish Habitat (Preferred Alternative)

Pursuant to the Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of electromagnetic devices during training and testing activities may have minimal and temporary adverse effects on fishes that occupy water column habitat by reducing the quality or quantity of water column (electro-chemical environment) that constitutes Essential Fish Habitat or Habitat Areas of Particular Concern (U.S. Department of the Navy 2013).

3.9.3.2.2 Impacts from High Energy Lasers

This section analyzes the potential impacts of high energy lasers on fish. As discussed in Section 3.0.5.3.2.2 (Lasers), high energy laser weapons are designed to disable surface targets, rendering them immobile. The primary concern is the potential for a fish to be struck by a laser beam at or near the water's surface, which could result in injury or death.

Marine fish could be exposed to a laser only if the beam missed the target. Should the laser strike the sea surface, individual fish at or near the surface could be exposed. The potential for exposure to a high energy laser beam decreases as the water depth increases. Most marine fish are not susceptible to laser exposure because they are benthic or primarily occur more than a few meters below the sea surface.

3.9.3.2.2.1 No Action Alternative

Under the No Action Alternative, no high energy lasers would be used during training or testing activities.

3.9.3.2.2.2 Alternatives 1 and Alternative 2 (Preferred Alternative)

Training Activities

Under Alternatives 1 and 2, no high energy lasers would be used during training activities.

Testing Activities

Under Alternatives 1 and 2, high energy laser weapons tests would be introduced in the Northeast U.S. Continental Shelf Large Marine Ecosystem and Gulf Stream Open Ocean Area—specifically within the VACAPES Range Complex (see Section 3.0.5.3.2.2, Lasers).

Fish species that do not occur within the VACAPES Range Complex or that do not occur near the sea surface—including the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, and Gulf sturgeon—would not be exposed to high energy lasers. Species that do occur within this area, and occur near the sea surface, would have the potential to be exposed. Both Atlantic and shortnose sturgeon could occur occasionally in the VACAPES Range Complex. However, these species are mainly nearshore species and spend the majority of their time at or near the bottom. It is very unlikely that an individual would surface at the exact moment in the exact place that the laser hit the surface. Fish are unlikely to be exposed to high energy lasers based on: the (1) relatively low number of events, (2) very localized potential impact area of the laser beam, and (3) temporary duration of potential impact (seconds).

Pursuant to the ESA, the use of high energy lasers during testing activities as described under Alternatives 1 and 2:

- *will have no effect on ESA-listed Atlantic salmon, largetooth sawfish, shortnose sturgeon, Atlantic sturgeon, Gulf sturgeon or smalltooth sawfish and*
- *will have no effect on ESA-listed Atlantic salmon, smalltooth sawfish, or Gulf sturgeon critical habitat.*

3.9.3.3 Physical Disturbance and Strike Stressors

This section evaluates the potential impacts of various types of physical disturbance and strike stressors associated with Navy training and testing activities within the Study Area. Section 3.0.5.3.3 (Physical Disturbance and Strike Stressors) discusses the activities that may produce physical disturbance and strike stressors.

Physical disturbance and strike stressors from vessels and in-water devices, military expended materials, and seafloor devices have the potential to affect all marine fish groups found within the Study Area (Table 3.9-3), although some fish groups are more susceptible to strike potential than others. The potential responses to physical strikes are varied, but include behavioral changes such as avoidance, altered swimming speed and direction, physiological stress, and physical injury or mortality. Despite their ability to detect approaching vessels using a combination of sensory cues (sight, hearing, and lateral line), larger slow-moving fish (e.g., sturgeon, whale sharks, basking sharks, and manta rays) cannot avoid all collisions, with some collisions resulting in mortality (Speed et al. 2008).

How a physical strike impacts a fish depends on the relative size of the object potentially striking the fish and the location of the fish in the water column. Before being struck by an object, Atlantic salmon for example, would sense a pressure wave through the water (Hawkins and Johnstone 1978) and have the ability to swim away from the oncoming object. The movement generated by a large object moving through the water would simply displace small fish in open water, such as Atlantic herring. Some fish might have time to detect the approaching object and swim away; others could be struck before they become aware of the object. An open-ocean fish that is displaced a small distance by movements from an object falling into the water nearby would likely continue on its original path as if nothing had happened. However, a bottom-dwelling fish near a sinking object would likely be disturbed, and may exhibit a general stress response, as described in Section 3.0.5.7 (Biological Resource Methods). As in all vertebrates, the function of the stress response in fish is to rapidly raise the blood sugar level to prepare the fish to flee or fight (Helfman et al. 2009). This generally adaptive physiological response can become a liability to the fish if the stressor persists and the fish is not able to return to its baseline physiological state. When stressors are chronic, the fish may experience reduced growth, health, or survival (Wedemeyer et al. 1990). If the object hits the fish, direct injury (in addition to stress) or death may result.

Many fish respond to a sudden physical approach or contact by darting quickly away from the stimulus. Some other species may respond by freezing in place and adopting cryptic coloration. Some other species may respond in an unpredictable manner. Regardless of the response, the individual must stop its current activity and divert its physiological and cognitive attention to responding to the stressor (Helfman et al. 2009). The energy costs of reacting to a stressor depend on the specific situation, but in all cases the caloric requirements of stress reactions reduce the amount of energy available to the fish for other functions, such as predator avoidance, reproduction, growth, and maintenance (Wedemeyer et al. 1990).

The ability of a fish to return to its previous activity following a physical strike (or near-miss resulting in a stress response) is a function of a variety of factors. Some fish species are more tolerant of stressors than others and become re-acclimated more easily. Experiments with species for use in aquaculture have revealed the immense variability among species in their tolerance to physical stressors. Within a species, the rate at which an individual recovers from a physical strike may be influenced by its age, sex, reproductive state, and general condition. A fish that has reacted to a sudden disturbance by swimming at burst speed would tire after only a few minutes; its blood hormone and sugar levels (cortisol and glucose) may not return to normal for up to, or longer than, 24 hours. During its recovery period, the fish would not be able to attain burst speeds and would be more vulnerable to predators (Wardle 1986). If the individual were not able to regain a steady state following exposure to a physical stressor, it may suffer reduced immune function and even death (Wedemeyer et al. 1990).

Potential impacts of physical disturbance and strike to adults may be different than for other life stages (e.g., eggs, larvae, juveniles) because these life stages do not necessarily occur together in the same location (Botsford et al. 2009; Sabates et al. 2007), and because they have different response capabilities. The numbers of eggs and larvae exposed to vessel movements would be low relative to total ichthyoplankton biomass (Able and Fahay 1998); therefore, measurable effects on fish recruitment would not be expected. Also, the early life stages of most marine fish (excluding sharks and other livebearers) already have extremely high natural mortality rates (10 to 85 percent per day) from predation on these life stages (Helfman et al. 2009), and therefore, most eggs and larvae are not expected to survive to the next life stage, as demonstrated by equivalent adult modeling (Horst 1977).

3.9.3.3.1 Impacts from Vessels and In-Water Devices

The majority of the training activities under all alternatives involve vessels, and a few of the activities involve the use of in-water devices. For a discussion of the types of activities that use vessels and in-water devices, where they are used, and how many activities would occur under each Alternative, see Section 3.0.5.3.3 (Physical Disturbance and Strike Stressors). See Table 3.0-25 for a representative list of Navy vessel types, lengths, and speeds and Table 3.0-37 for the types, sizes, and speeds of Navy in-water devices used in the Study Area. Figures 3.0-20 and 3.0-21 provide graphics that illustrate the location and relative use of vessels under the Preferred Alternative. Vessels and in-water devices are covered together in this section because they both present similar potential impacts on fish. Vessels and in-water devices do not normally collide with adult fish, most of which can detect and avoid them. One study on fish behavioral responses to vessels showed that most adults exhibit avoidance responses to engine noise, sonar, depth finders, and fish finders (Jørgensen et al. 2004), reducing the potential for vessel strikes. Misund (1997) found that fish ahead of a ship that showed avoidance reactions did so at ranges of 160–490 ft. (50–350 m). When the vessel passed over them, some fish responded with sudden escape responses that included lateral avoidance or downward compression of the school. Conversely, Rostad (2006) observed that some fish are attracted to different types of vessels (e.g., research vessels, commercial vessels) of varying sizes, noise levels, and habitat locations. Fish behavior in the vicinity of a vessel is therefore quite variable, depending on the type of fish, its life history stage, behavior, time of day, and the sound propagation characteristics of the water (Schwartz 1985). Early life stages of most fish could be displaced by vessels and not struck in the same manner as adults of larger species. However, a vessel's propeller movement or propeller wash could entrain early life stages. The low-frequency sounds of large vessels or accelerating small vessels caused avoidance responses among herring (Chapman and Hawkins 1973), but avoidance ended within 10 seconds after the vessel departed. Because a towed in-water device is continuously moving, most fish are expected to move away from it or to follow behind it, in a manner similar to their responses to a vessel. When the device is removed, most fish would simply move to another area.

There are a few notable exceptions to this assessment of potential vessel strike impacts on marine fish groups. Large slow-moving fish such as sturgeon, ocean sunfish, whale sharks, basking sharks, and manta rays occur near the surface in open-ocean and coastal areas, and are more susceptible to ship strikes, causing blunt trauma, lacerations, fin damage, or mortality. Speed et al. (2008) evaluated this specifically for whale sharks, but these other large slow-moving fish are also likely to be susceptible because of their similar behavior and location in the water column. Increases in the numbers and sizes of shipping vessels in the modern cargo fleets make it difficult to gather mortality data because personnel on large ships are often unaware of whale shark collisions (Stevens 2007), therefore, the occurrence of whale shark strikes is likely much higher than has been documented by the few studies that have been conducted. The results of a whale shark study outside of the Study Area in the Gulf of Tadjoura, Djibouti, revealed that of the 23 whale sharks observed during a five-day period, 65 percent had scarring from boat and propeller strikes (Rowat et al. 2007). Based on the typical physiological responses described in Section 3.9.3.3 (Physical Disturbance and Strike Stressors), vessel movements are not expected to compromise the general health or condition of individual fish, except for large slow-moving fish such as whale sharks, basking sharks, manta rays, sturgeon, and ocean sunfish.

3.9.3.3.1.1 No Action Alternative, Alternative 1, and Alternative 2 (Preferred Alternative)

Section 3.0.5.3.3.1 (Vessels) and Section 3.0.5.3.3.2 (In-Water Devices) provide estimates of relative vessel use and location for each of the alternatives. These estimates are based on the number of activities predicted for each alternative. While these estimates predict use, actual Navy vessel usage depends on military training requirements, deployment schedules, annual budgets, and other unpredictable factors. Training and testing concentrations mostly depend on locations of Navy shore installations and established training and testing areas. Even with the introduction of the Undersea Warfare Training Range, these areas have not appreciably changed in the last decade and are not expected to change in the foreseeable future. Under Alternatives 1 and 2, the Study Area would be expanded from the No Action Alternative and the number of events may increase, but the concentration of vessel and in-water device use and the manner in which the Navy trains and tests would remain consistent with the range of variability observed over the last decade. This is partly because multiple activities occur from the same vessel platform. Therefore, the increased number of activities estimated for Alternatives 1 and 2 is not expected to result in an increase in vessel use or transit. 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 strikes are expected to occur is likely to remain consistent with the previous decade or be reduced because of the implementation of mitigation measures as outlined in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring). The difference in activities from the No Action Alternative to Alternative 1 and Alternative 2, shown in Table 3.0-36, is not likely to change the probability of a vessel strike in any meaningful way.

Training Activities

As indicated in Section 3.0.5.3.3.2 (In-Water Devices), training activities involving in-water devices occur in the Gulf of Mexico, Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems as well as Gulf Stream Open Ocean Area—specifically within the Northeast, VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes. Use of in-water devices is concentrated within the VACAPES Range Complex. The differences in the number of in-water device activities between alternatives increases by less than two times under Alternative 1 and Alternative 2 compared to the No Action Alternative. Species that do not occur near the surface within the Study Area—including the ESA-listed Atlantic salmon—would not be exposed to in-water device strike potential. Species that occur near the surface within the Study Area—including the ESA-listed largetooth sawfish, smalltooth sawfish, Atlantic sturgeon, shortnose sturgeon, and Gulf sturgeon—would have the potential to be exposed to in-water device strikes.

Operational features of in-water devices and their use substantially limit the exposure of fish to potential strikes. First, in-water devices would not pose any strike risk to benthic fish because the towed equipment is designed to stay off the bottom. Prior to deploying a towed in-water device, there is a standard operating procedure to search the intended path of the device for any floating debris (i.e., driftwood) or other potential obstructions (i.e., *Sargassum* rafts and animals), since they have the potential to cause damage to the device. Therefore, the device would not be used in areas where pelagic (open ocean) fish naturally aggregate.

As indicated in Sections 3.0.5.3.3.1 (Vessels), the majority of the training activities under all alternatives involve vessels, and a few of the activities involve the use of in-water devices. See Table 3.0-25 for a representative list of Navy vessel types, lengths, and speeds and Table 3.0-37 for the types, sizes, and speeds of Navy in-water devices used in the Study Area. Figure 3.0-20 provides graphics that illustrate the location and relative use of vessels under the Preferred Alternative. These activities do not differ seasonally and could be widely dispersed throughout the Study Area, but would be more concentrated near naval ports, naval piers, and range areas. Navy training vessel traffic would especially be concentrated in the Northeast U.S. Continental Shelf Large Marine Ecosystem near Naval Station Norfolk in Norfolk, Virginia, and in the Southeast U.S. Continental Shelf Large Marine Ecosystem near Naval Station Mayport in Jacksonville, Florida.

Based on the primarily nearshore distribution of Atlantic, shortnose, and Gulf sturgeon and overlap of in-water device use, potential strike risk would be greatest in the lower Chesapeake Bay and nearshore waters of the GOMEX Range Complex, although a minor potential exists for strikes of Atlantic and Gulf sturgeon within waters less than 50 to 60 m in depth within any of the ranges.

The likelihood of strikes by towed mine warfare devices on adult or juvenile fish, which could result in injury or mortality, would be extremely low because these life stages are highly mobile. The use of in-water devices may result in short-term and local displacement of fish in the water column. However, these behavioral reactions are not expected to result in substantial changes to an individual's fitness, or species recruitment, and are not expected to result in population-level impacts. Ichthyoplankton (fish eggs and larvae) in the water column could be displaced, injured, or killed by towed mine warfare devices. The numbers of eggs and larvae exposed to vessels or in-water devices would be extremely low relative to total ichthyoplankton biomass (Able and Fahay 1998); therefore, measurable changes on fish recruitment would not occur.

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. Because vessel use is so widespread, all of the ESA-listed fish species would have the potential to be exposed to vessel strikes. Smaller vessels would be more concentrated in the coastal areas close to naval installations, ports, and ranges. Species that do occur near the surface in the Study Area, including all ESA-listed species would have the potential to be exposed to vessel strikes.

Exposure of fish to vessel strike stressors is limited to those fish groups identified in Section 3.9.2 (Affected Environment) that are large, slow-moving, and may occur near the surface, such as sturgeon, ocean sunfish, whale sharks, basking sharks, and manta rays. With the exception of sturgeon, these species are distributed widely in offshore portions of the Study Area. Any isolated cases of a Navy vessel striking an individual could injure that individual, impacting the fitness of an individual fish. Vessel strikes would not pose a risk to most of the other marine fish groups, because many fish can detect and avoid vessel movements, making strikes rare and allowing the fish to return to their normal behavior after the ship or device passes. As a vessel approaches a fish, they could have a detectable behavioral or physiological response (e.g., swimming away and increased heart rate) as the passing vessel displaces them. However, such reactions are not expected to have lasting effects on the survival, growth, recruitment, or reproduction of these marine fish groups at the population level.

All of the ESA-listed fish species occurring in training areas would be potentially exposed to vessel strikes. Atlantic salmon are fast swimmers but typically occur in the top 10 ft. (3 m) of the water column while moving through coastal waters (Hedger et al. 2009). The salmon can sense pressure changes in the water column and swim quickly (Baum 1997; Popper and Hastings 2009a), and are likely to escape collision with vessels. Therefore, while vessels and in-water devices could overlap with Atlantic salmon, the likelihood of a strike would be extremely low, with discountable effects.

All sturgeon are restricted to the waters of the continental shelf; particularly the shallow, coastal, or nearshore waters of the Study Area (Dadswell 2006; Ross et al. 2009) and, therefore, could be exposed to vessel strikes only in these locations. Because of the concentration of Navy vessel movements near Norfolk (Lower Chesapeake Bay, VACAPES Range Complex) and Mayport (JAX Range Complex), vessel activity during training could overlap with sturgeon occupying these waters.

The behavior of sturgeons in rivers and estuaries includes occasional use of the surface waters, which could expose them to vessel strikes (Watanabe et al. 2012). In estuarine areas, Brown and Murphy (2010) found that 28 deaths of Atlantic sturgeon in the Delaware River estuary were reported over a four-year period, between 2005 and 2008. Of those, 50 percent were caused by vessel collisions, although the size or types of the vessels were unknown. An unknown number of additional sturgeon was likely struck by vessels that was not included in this total. Based on an egg-per-recruit analysis of the Delaware River population, an annual mortality rate of 2.5 percent of the females could have adverse impacts on the population (Brown and Murphy 2010). Data from 2009 were analyzed by Mintz and Filadelfo (2011) and indicated that along the Atlantic U.S. Exclusive Economic Zone, Navy vessels accounted for slightly less than 6 percent of the total large vessel traffic (from estimated hours) in that area. In the VACAPES and JAX Range Complexes where Navy vessel activity is concentrated, the Navy vessels accounted for 7 percent and 9 percent (respectively) of the total large vessel traffic. Barco et al. (2009) found that military vessels were 10.4 percent of the total vessels transiting (inbound and outbound) the Chesapeake Bay channel, an area of highly concentrated Navy activity because of the proximity of Naval Station Norfolk. When smaller vessels (less than 65 ft. [20 m] in length) are included in the total estimates of vessel traffic, the percentage of vessels attributable to Navy activities is reduced.

The Atlantic sturgeon populations of Chesapeake Bay (and VACAPES Range Complex) are extremely low (National Marine Fisheries Service 2007; Waldman and Wirgin 1998) and shortnose sturgeon populations are concentrated in the upper portion of the bay (Welsh et al. 2002), outside of the Study Area and away from Navy vessel traffic. In addition, within the Chesapeake Bay, most of the Navy vessel traffic is large vessels that travel in deeper channels and at slow safe speeds during navigation within the bay.

Navy vessel activity during training exercises is less concentrated in the GOMEX Range Complex, where training could overlap with Gulf sturgeon. Sawfish are restricted to shallow coastal waters of South Florida and the Gulf of Mexico, usually near the ocean bottom. They typically would only be found near the surface while in very shallow water (less than 1 m) deep associated with inshore (within estuaries or barrier islands) mangrove and seagrass habitats (Poulakis and Seitz 2004; Simpfendorfer 2006). These habitats do not overlap with Navy vessel movements during training activities in these areas.

There is no overlap of the stressor with designated critical habitat for Atlantic salmon, smalltooth sawfish, or Gulf sturgeon. All of the primary constituent elements required by Atlantic salmon are applicable to freshwater only and are outside the Study Area. Therefore, vessels and in-water devices would not affect Atlantic salmon critical habitat. The primary constituent elements for smalltooth sawfish are red mangrove habitats and shallow marine waters of less than 1 m deep. In-water devices are not used in these shallow areas. Amphibious landings would occur at these shallow depths, but not in mangrove areas (just at Onslow Beach and Seminole Beach) and thus would not overlap with smalltooth sawfish critical habitat. The only applicable primary constituent element of critical habitat for Gulf sturgeon is “abundant food items” (e.g., amphipods, polychaetes, gastropods, ghost shrimp, isopods, molluscs, and crustaceans). Vessels and in-water devices are not expected to impact these invertebrate populations, as described in Section 3.8 (Marine Invertebrates), therefore, no effects are expected on the abundance of these food items for Gulf sturgeon that contribute to the conservation value of its critical habitat.

The risk of a strike from vessels and in-water devices used in training activities would be extremely low because (1) most fish can detect and avoid vessel and in-water device movements, and (2) the types of fish that are likely to be exposed to vessel and in-water device strike are limited and occur in low concentrations where vessels and in-water devices are used. Potential impacts of exposure to vessels and in-water devices are not expected to result in substantial changes to an individual's behavior, fitness, or species recruitment, and are not expected to result in population-level impacts.

Pursuant to the ESA, the use of vessels and in-water devices during training activities as described under the No Action Alternative, Alternative 1, and Alternative 2:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, or shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon; and*
- *will have no effect on ESA-listed Atlantic salmon, smalltooth sawfish, or Gulf sturgeon critical habitat.*

Testing Activities

As indicated in Section 3.0.5.3.3.2 (In-Water Devices), testing activities involving in-water devices occur in the Gulf of Mexico and Northeast U.S. Continental Shelf Large Marine Ecosystems, as well as Gulf Stream Open Ocean Area—specifically within the Northeast Range Complexes; the South Florida Ocean Measurement Facility Testing Range; and Naval Surface Warfare Center, Panama City Division Testing Range. The differences in the number of in-water device activities between alternatives increases by more than two times under Alternative 1 and Alternative 2 compared to the No Action Alternative. Species that occur in these areas, including all ESA-listed species would have the potential to be exposed to in-water devices.

As described for training in Section 3.9.3.3.1.1 (No Action Alternative, Alternative 1, and Alternative 2 [Preferred Alternative]), the use of in-water devices may result in short-term and local displacement of fish in the water column. Atlantic salmon would not be exposed to in-water devices during testing activities in the Naval Undersea Warfare Center Division, Newport Testing Range, because the Atlantic salmon distinct population segment does not occur at that location; they could be exposed to in-water devices during testing activities in the Northeast Range Complexes. Atlantic salmon are a fast-moving fish would likely be able to avoid a collision with an in-water device. These behavioral reactions are not expected to result in substantial changes to an individual's fitness, or species recruitment, and are not expected to result in population-level impacts.

As indicated in Sections 3.0.5.3.3.1 (Vessels), Navy testing vessel traffic would especially be concentrated in the Northeast U.S. Continental Shelf Large Marine Ecosystem near Naval Station Norfolk in Norfolk, Virginia, and in the Southeast U.S. Continental Shelf Large Marine Ecosystem near Naval Station Mayport in Jacksonville, Florida. Because vessel use is so widespread, all of the ESA-listed fish species would have the potential to be exposed to vessel strikes.

Exposure of fish to vessel and in-water device strikes is limited to those marine fish groups identified in Section 3.9.2 (Affected Environment) that are susceptible to vessel strikes, including large and slow-moving species, such as sturgeon, ocean sunfish, whale sharks, basking sharks, and manta rays that typically occur near the surface in open-ocean and coastal areas. Any isolated cases of a Navy vessel potentially striking an individual fish could injure the animal and impact its fitness, but is not expected to result in any lasting effects on the survival, growth, recruitment, or reproduction of marine fish species.

All of the ESA-listed fish species occurring in testing areas would be potentially exposed to vessel strikes. During some testing activities, vessels require operation at high speeds in the VACAPES Range Complex, which could potentially strike an Atlantic or shortnose sturgeon. The limited number of activities that occur at high speeds could increase the risk of strike to a sturgeon. Also for reasons stated in Section 3.9.3.3.1.1 (No Action Alternative, Alternative 1 and Alternative 2 [Preferred Alternative]), the likelihood of a vessel strike during other testing activities would be very low, and vessel movement is not expected to result in any lasting effects on the survival, growth, recruitment, or reproduction of ESA-listed species In addition, there is no overlap of the stressor with designated critical habitat or the primary constituent elements that contribute to the conservation value of critical habitat for Atlantic salmon, smalltooth sawfish, or Gulf sturgeon.

The risk of a strike from vessels and in-water devices used in testing activities would be extremely low because (1) most fish can detect and avoid vessel and in-water device movements, and (2) the types of fish that are likely to be exposed to vessel and in-water device strike are limited and occur in low concentrations where vessels and in-water devices are used. Potential impacts of exposure to vessels and in-water devices are not expected to result in substantial changes to an individual's behavior, fitness, or species recruitment, and are not expected to result in population-level impacts.

Pursuant to the ESA, the use of vessels and in-water devices during testing activities as described under the No Action Alternative, Alternative 1, and Alternative 2:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, or shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon; and*
- *will have no effect on ESA-listed Atlantic salmon, smalltooth sawfish, or Gulf sturgeon critical habitat.*

3.9.3.3.2 Impacts from Military Expended Materials

This section analyzes the strike potential to marine fish of the following categories of military expended materials: (1) non-explosive practice munitions, (2) fragments from high-explosive munitions, and (3) expended materials other than munitions, such as sonobuoys, vessel hulks, parachutes, fiber optic cables and guidance wires, and expendable targets. For a discussion of the types of activities that use military expended materials, where they are used, and how many activities would occur under each alternative, see Section 3.0.5.3.3.3 (Military Expended Material Strikes). Analysis of all potential impacts (disturbance, strike, ingestion, entanglement) of military expended materials on critical habitat is included in this section.

While disturbance or strike from any of these objects as they sink through the water column is possible, it is not very likely for most expended materials because the objects generally sink through the water slowly and can be avoided by most fish. Therefore, with the exception of sinking exercises, the discussion of military expended materials strikes focuses on strikes at the surface or in the upper water column from fragments (of high-explosives) and projectiles because those items have a greater potential for a fish strike as they hit the water, before slowing down as they move through the water column.

Vessel Hulk. During a sinking exercise, aircraft, ship, and submarine crews fire or drop munitions on a seaborne target, usually a clean deactivated ship, Section 3.1 (Sediments and Water Quality), which is deliberately sunk using multiple weapon systems. Sinking exercises occur in specific open ocean areas, outside of the coastal range complexes, in waters exceeding 3,000 m in depth, as shown in Figures 3.0-2 and 3.0-3. Direct ordnance strikes from the various weapons used in these exercises are a source of potential impact. However, these impacts are discussed for each of those weapons categories in this section and are not repeated in the respective sections. Therefore, the analysis of sinking exercises as a strike potential for benthic fish is discussed in terms of the ship hulk landing on the seafloor.

Small-, Medium-, and Large-Caliber Projectiles. Various types of projectiles could cause a temporary (seconds), localized impact when they strike the surface of the water. Current Navy training and testing in the Study Area, such as gunnery exercises, include firing a variety of weapons and using a variety of non-explosive training and testing rounds, including 5-in. naval gun shells, and small-, medium-, and large-caliber projectiles. See Table 3.0-70 for information regarding the number and location of activities involving non-explosive practice munitions. The larger-caliber projectiles are primarily used in the open ocean beyond 20 nm. Direct ordnance strikes from firing weapons are potential stressors to fish. There is a remote possibility that an individual fish at or near the surface may be struck directly if it is at the point of impact at the time of non-explosive practice munitions delivery. Expended rounds may strike the water surface with sufficient force to cause injury or mortality. However, limited fish species swim right at, or near, the surface of the water (e.g., with the exception of pelagic sharks, herring, salmonids, flying fish, jacks, tuna, mackerels, billfish, ocean sunfish, and other similar species).

Various projectiles will fall on soft or hard bottom habitats, where they could either become buried immediately in the sediments, or sit on the bottom for an extended time period. Except for the 5-in. and the 30 mm rounds, which are fired from a helicopter, all projectiles would be aimed at surface targets. These targets will absorb most of the projectiles’ energy before they strike the surface of the water and sink. This factor would limit the possibility of high-velocity impacts with fish from the rounds entering the water. Furthermore, fish can quickly and easily leave an area temporarily when vessels or helicopters approach. It is reasonable to assume, therefore, that fish will leave an area prior to, or just after the onset of, projectile firing and will return once activities are completed.

Most munitions would sink through the water column and come to rest on the seafloor, stirring up sediment and possibly inducing a startle response, displacing, or injuring nearby fish in extremely rare cases. Particular impacts on a given fish species would depend on the size and speed of the munitions, the water depth, the number of rounds delivered, the frequency of training and testing, and the sensitivity of the fish.

Bombs, Missiles, and Rockets. Direct munitions strikes from bombs, missiles, and rockets are potential stressors to fish. Some individual fish 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. A limited number of fish swim right at, or near, the surface of the water, as described for small, medium, and large-caliber projectiles.

As discussed in Appendix G (Statistical Probability Model for Estimating Direct Strike Impact and Number of Potential Exposures), statistical modeling conducted for the Study Area indicates that the probability of military expended materials striking marine mammals or sea turtles is extremely low. Statistical modeling could not be conducted to estimate the probability of military expended material strikes on fish, because fish density data are not available at the scale of an OPAREA or testing range.

In lieu of strike probability modeling, the number, size, and area of potential impact (or "footprints") of each type of military expended material is presented in Tables 3.3-9 through 3.3-13. The application of this type of footprint analysis to fish follows the notion that a fish occupying the impact area could be susceptible to potential impacts, either at the water surface (e.g., pelagic sharks, herring, salmonids, flying fish, jacks, tuna, mackerels, billfish, and ocean sunfish [see Table 3.9-3]) or as military expended material falls through the water column and settles to the bottom (e.g., flounders, skates, and other benthic fish listed in Table 3.9-3). Furthermore, most of the projectiles fired during training and testing activities are fired at targets, and most projectiles hit those targets, so only a very small portion of those would hit the water with their maximum velocity and force. Of that small portion, a small number of fish at or near the surface (pelagic fish) or near the bottom (benthic fish) may be directly impacted if they are in the target area and near the expended item that hits the water surface (or bottom), but population-level impacts would not occur.

Propelled fragments are produced by an exploding bomb. Close to the explosion, fish could potentially sustain injury or death from propelled fragments (Stuhmiller et al. 1990). However, studies of underwater bomb blasts show that fragments are larger than those produced during air blasts and decelerate much more rapidly (O'Keeffe and Young 1984; Swisdak Jr. and Montaro 1992), reducing the risk to marine organisms.

Fish disturbance or strike could result from bomb fragments (after explosion) falling through the water column in very small areas compared to the vast expanse of the testing ranges, OPAREAs, range complexes, or the Study Area. The expected reaction of fish exposed to this stressor would be to immediately leave the area where bombing is occurring, thereby reducing the probability of a fish strike after the initial expended materials hit the water surface. When a disturbance of this type concludes, the area would be repopulated and the fish stock would rebound with inconsequential impacts on the resource (Lundquist et al. 2010).

3.9.3.3.2.1 No Action Alternative

Training Activities

Tables 3.0-70 to 3.0-73 list the number and location of military expended materials, most of which are small- and medium-caliber projectiles. As indicated in Section 3.0.5.3.3.3 (Military Expended Material Strikes), under the No Action Alternative, the areas with the greatest amount of expended materials are expected to be the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems and the Gulf Stream Open Ocean Area—specifically within the Northeast, VACAPES, Navy Cherry Point, JAX, Key West, and GOMEX Range Complexes, and in the Other AFTT Areas while vessels are in transit. Activities using military expended materials are concentrated within VACAPES and JAX Range Complexes. Species that occur in these areas, including all ESA-listed species, would have the potential to be exposed to military expended material strikes.

Marine fish groups identified in Section 3.9.2 (Affected Environment) that are particularly susceptible to military expended material strikes are those occurring at the surface, within the offshore and continental shelf portions of the range complexes (where the strike would occur). Those groups include pelagic sharks, herring, salmonids, flying fish, jacks, tuna, mackerels, billfish, ocean sunfish, and other similar species (Table 3.9-3). Additionally, certain deep-sea fish would be exposed to strike risk as a ship hulk, expended during a sinking exercise, settles to the seafloor. These groups include hagfish, dragonfish, lanternfish, Aulopiformes, anglerfish, and oarfish.

Sinking exercises occur in open ocean areas, outside of the coastal range complexes, shown in Figures 3.0-2 and 3.0-3. While serious injury or mortality to individual fish would be expected if they were present within range of high-explosive activities (analyzed in Section 3.9.3.1, Acoustic Stressors), sinking exercises under the No Action Alternative would not result in impacts on pelagic fish populations at the surface based on the placement of these activities in deep ocean areas where fish abundance is low or widely dispersed. Also, these activities are very few in number each year. Disturbances to benthic fish from sinking exercises would be highly localized to the sinking exercise box. Any deep-sea fish on the bottom where a ship hulk would settle could experience displacement, injury, or death. However, population level impacts on the deep-sea fish community would not occur because of the limited spatial extent of the impact and the wide dispersal of fish in deep ocean areas.

Projectiles, bombs, missiles, rockets, and associated fragments have the potential to directly strike fish as they hit the water surface and below the surface to the point where the projectile loses its forward momentum. Fish at the surface, and just below, would be most susceptible to injury or death from strikes, because velocity of these materials would rapidly decrease upon contact with the water and as they travel through the water column. Consequently, most water column fish would have ample time to detect and avoid approaching munitions or fragments that fall through the water column. The probability of strike based on the “footprint” analysis included in Table 3.3-9 indicates that even for an extreme case of expending all small-caliber projectiles within a single gunnery box, the probability of any of these items striking a fish (even as large as bluefin tuna or whale sharks) is extremely low. Therefore, since most fish are smaller than bluefin tuna or whale sharks, and most military expended materials are less abundant than small-caliber projectiles, the risk of strike by these items is exceedingly low for fish overall. A possibility exists that a small number of fish at or near the surface may be directly impacted if they are in the target area and near the point of physical impact at the time of military expended material strike, but population-level impacts would not occur.

Training activities involving military expended materials could impact marine fish within the areas where the training is occurring. Each range complex within the Study Area is evaluated in Table 3.3-9 (see Section 3.3, Marine Habitats) to determine what the footprint and resulting level of impact could be under the No Action Alternative. Based on that analysis, the total footprint area of expended materials is less than 1/10,000 of 1 percent (less than 0.0001 percent) of each range complex. Therefore, the probability of any of these expended items striking a fish is exceedingly low, and population-level impacts would not be expected.

All of the ESA-listed fish species occurring in training areas would be potentially exposed to military expended materials. The Atlantic salmon occurs only in the Northeast Range Complexes and in the three northernmost large marine ecosystems, where the density of military expended materials is very low. Therefore, while military expended materials could overlap with Atlantic salmon, the likelihood of a strike would be extremely low, with discountable effects. All sturgeon are restricted to the continental shelf, particularly the shallow, coastal, or nearshore waters of the Study Area (Dadswell 2006; Ross et al. 2009), and, therefore, could be exposed to military expended materials only in these locations. Sawfish are restricted to shallow coastal waters of South Florida and the Gulf of Mexico, usually near the ocean bottom. They typically would only be found near the surface while in very shallow water (less than 1 m deep) associated with inshore (within estuaries or barrier islands), mangrove, and seagrass habitats

(Poulakis and Seitz 2004; Simpfendorfer 2006). These habitats do not overlap with military expended material use during training activities in these areas.

There is no overlap of the stressor with designated critical habitat for Atlantic salmon or smalltooth sawfish. All of the primary constituent elements required by Atlantic salmon are applicable to freshwater only and are outside the Study Area. Therefore, none of the military expended materials would affect Atlantic salmon critical habitat. The primary constituent elements for smalltooth sawfish are red mangrove habitats and shallow marine waters of less than 1 m deep. No activities involving military expended materials would occur at these depths and thus would not overlap with smalltooth sawfish critical habitat. Military expended materials (e.g., parachutes, guidance wires, and fiber optic cables) could be expended within Gulf sturgeon critical habitat. However, the only applicable primary constituent element of critical habitat for Gulf sturgeon is “abundant food items” (e.g., amphipods, polychaetes, gastropods, ghost shrimp, isopods, molluscs, and crustaceans). Military expended materials are not expected to impact these invertebrate populations, as described in Section 3.8 (Marine Invertebrates); therefore, while the stressor overlaps Gulf sturgeon critical habitat, no impacts are expected on the abundance of these food items for Gulf sturgeon that contribute to the conservation value of its critical habitat.

The impact of military expended material strikes would be inconsequential due to: (1) the limited number of species found directly at the surface where military expended material strikes could occur, (2) the rare chance that a fish might be directly struck at the surface by military expended materials, (3) the ability of most fish to detect and avoid an object falling through the water below the surface, and (4) the low probability of strike based on impact footprint area. The potential impacts of military expended material strikes would be short-term (seconds) and localized disturbances of the water surface (and seafloor areas within sinking exercise boxes) and are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction at the population level.

Pursuant to the ESA, the use of military expended materials during training activities as described under the No Action Alternative:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon;*
- *will have no effect on Atlantic salmon, or smalltooth sawfish critical habitat; and*
- *may affect but is not likely to adversely affect critical habitat for Gulf sturgeon.*

Testing Activities

Table 3.0-70 to Table 3.0-73 list the number and location of military expended materials, most of which are small- and medium-caliber projectiles. As indicated in Section 3.0.5.3.3.3 (Military Expended Material Strikes), under the No Action Alternative, the areas with the greatest amount of expended materials are expected to be the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems and the Gulf Stream Open Ocean Area—specifically within the Naval Surface Warfare Center, Panama City Division Testing Range; the Northeast, VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes; and in the Other AFTT Areas. Activities using military expended materials are concentrated within VACAPES Range Complex and Naval Surface Warfare Center, Panama City Division Testing Range. Species that occur in these areas, including all ESA-listed species would have the potential to be exposed to military expended material strikes.

The differences in species overlap and potential impacts of military expended material strikes on marine fish groups and ESA-listed species during testing activities would not be discernible from those described for training activities in Section 3.9.3.3.2.1 (No Action Alternative). Adult Gulf sturgeon may occur in St. Andrew Bay (Florida) during fall and winter (U.S. Fish and Wildlife Service 2004, 2006). Also, St. Andrew Bay is not part of any of the major freshwater river systems that Gulf sturgeon use during freshwater migration. The smalltooth sawfish may also occur in St. Andrew Bay; however, only three smalltooth sawfish encounters have been reported and verified since 1998 west of the mouth of St. Andrew Bay (Simpfendorfer and Wiley 2006).

Based on the analysis in Table 3.3-10, the total footprint area of expended materials is less than 1/10,000 of 1 percent (less than 0.0001 percent) of each testing range. Therefore, as described in the No Action Alternative, the probability of any of these expended items striking a fish is exceedingly low, and population-level effects would not be expected. Furthermore, the anticipated behavioral reactions are not expected to result in substantial changes to an individual's fitness, or species recruitment, and are not expected to result in population-level impacts. Similarly, military expended materials are not anticipated to affect any primary constituent elements of critical habitat for Atlantic salmon, smalltooth sawfish, or Gulf sturgeon. Specifically, parachutes, fiber optic cables, and guidance wires would overlap critical habitat for Gulf sturgeon only, but none of the primary constituent elements of Gulf sturgeon critical habitat would be affected (see discussion in Section 3.9.3.3.2.1, No Action Alternative).

The impact of military expended material strikes would be inconsequential due to: (1) the limited number of species found directly at or just below the surface where military expended material strikes could occur, (2) the rare chance that a fish might be directly struck at or just below the surface by military expended materials, (3) the ability of most fish to detect and avoid an object falling through the water below the surface, and (4) the low probability of strike based on impact footprint area. The potential impacts of military expended material strikes would be short-term (seconds) and localized disturbances of the water surface (and seafloor areas within the sinking exercise box) and are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction at the population level.

Pursuant to the ESA, the use of military expended materials during testing activities as described under the No Action Alternative:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon;*
- *will have no effect on ESA-listed Atlantic salmon or smalltooth sawfish critical habitat; and*
- *may affect but is not likely to adversely affect critical habitat for Gulf sturgeon.*

3.9.3.3.2.2 Alternative 1

Training Activities

Table 3.0-70 to Table 3.0-73 list the number and location of military expended materials, most of which are small- and medium-caliber projectiles. The number and footprint of military expended materials are detailed in Table 3.3-11. As indicated in Section 3.0.5.3.3.3 (Military Expended Material Strikes), under Alternative 1, the total amount of military expended materials is more than twice the amount expended in the No Action Alternative. The activities under Alternative 1 would occur in the same geographic locations as the No Action Alternative. Activities using military expended materials are concentrated within VACAPES, Navy Cherry Point, and JAX Range Complexes. Military expended materials would typically be of the same type listed under the No Action Alternative. Species that occur in these areas, including all ESA-listed species would have the potential to be exposed to military expended material strikes.

The differences in species overlap and potential impacts from military expended material strikes on marine fish groups and ESA-listed species during training activities would not be discernible from those described for training activities in Section 3.9.3.3.2.1 (No Action Alternative). Military expended materials hitting the water could result in an extremely unlikely strike of an individual fish, or more likely in a short-term and local displacement of fish in the water column. However, these behavioral reactions are not expected to result in substantial changes to an individual's fitness or species recruitment, and are not expected to result in population-level impacts (see Section 3.9.3.3.2.1, No Action Alternative). Similarly, military expended materials are not anticipated to affect any primary constituent elements of critical habitat for Atlantic salmon or smalltooth sawfish (see Section 3.9.3.3.2.1, No Action Alternative). Parachutes, fiber optic cables, and guidance wires would overlap critical habitat for Gulf sturgeon, but none of the primary constituent elements of Gulf sturgeon critical habitat would be affected (see discussion of the impacts from military expended materials in Section 3.9.3.3.2.1, No Action Alternative).

Alternative 1 would include a two-fold increase in small-caliber projectiles. For reasons stated in the No Action Alternative, the overall increase of military expended material under Alternative 1 would result in an increase in the strike risk; however, it would not rise to the level of being a concern. The potential impacts of military expended material strikes would be short-term (seconds) and localized disturbances of the water surface (and seafloor areas within the sinking exercise box) and are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction at the population level.

Pursuant to the ESA, the use of military expended materials during training activities as described under Alternative 1:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon;*
- *will have no effect on ESA-listed Atlantic salmon or smalltooth sawfish critical habitat; and*
- *may affect but is not likely to adversely affect critical habitat for Gulf sturgeon.*

Testing Activities

Table 3.0-70 to Table 3.0-73 list the number and location of military expended materials, most of which are small- and medium-caliber projectiles. The number and footprint of military expended materials are detailed in Table 3.3-12. As indicated in Section 3.0.5.3.3.3 (Military Expended Material Strikes), under Alternative 1, the total amount of military expended materials is nearly four times the amount expended in the No Action Alternative. The activities under Alternative 1 would occur in the same geographic locations as the No Action Alternative, with the exception of the introduction of activities in the South Florida Ocean Measurement Facility Testing Range and Key West Range Complex. Activities using military expended materials are concentrated within VACAPES Range Complex and Naval Surface Warfare Center, Panama City Division Testing Range. Military expended materials would typically be of the same type listed under the No Action Alternative. Species that occur in these areas, including all ESA-listed species would have the potential to be exposed to military expended material strikes.

The differences in species overlap and potential impacts of military expended material strikes on marine fish groups and ESA-listed species during testing activities would not be discernible from those described for training activities in Section 3.9.3.3.2.1 (No Action Alternative). Military expended materials hitting the water could result in an extremely unlikely strike of an individual fish, or more likely in a short-term and local displacement of fish in the water column. However, these behavioral reactions are not expected to result in substantial changes to an individual's fitness or species recruitment, and are not expected to result in population-level impacts (see Section 3.9.3.3.2.1, No Action Alternative). Similarly, military expended materials are not anticipated to affect any primary constituent elements of critical habitat for Atlantic salmon or smalltooth sawfish (see Section 3.9.3.3.2.1, No Action Alternative). Parachutes, fiber optic cables, and guidance wires would overlap critical habitat for Gulf sturgeon, but none of the primary constituent elements of Gulf sturgeon critical habitat would be affected (see discussion of the impacts from military expended materials in Section 3.9.3.3.2.1, No Action Alternative).

Alternative 1 would include a substantial increase in small-caliber projectiles. The overall increase of military expended material under Alternative 1 would result in an increase in the strike risk; however, it would not rise to the level of being a concern. The potential impacts of military expended material strikes would be short-term (seconds) and localized disturbances of the water surface (and seafloor areas within the sinking exercise box) and are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction at the population level.

Pursuant to the ESA, the use of military expended materials during testing activities as described under Alternative 1:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon;*
- *will have no effect on ESA-listed Atlantic salmon or smalltooth sawfish critical habitat; and*
- *may affect but is not likely to adversely affect critical habitat for Gulf sturgeon.*

3.9.3.3.2.3 Alternative 2 (Preferred Alternative)

Training Activities

The number and location of training activities under Alternative 2 are identical to training activities under Alternative 1. Therefore, impacts and comparisons to the No Action Alternative will also be identical as described in Section 3.9.3.3.2.2 (Alternative 1).

Pursuant to the ESA, the use of military expended materials during training activities as described under Alternative 2:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon;*
- *will have no effect on ESA-listed Atlantic salmon or smalltooth sawfish critical habitat; and*
- *may affect but is not likely to adversely affect critical habitat for Gulf sturgeon.*

Testing Activities

Table 3.0-70 to Table 3.0-73 list the number and location of military expended materials, most of which are small- and medium-caliber projectiles. The number and footprint of military expended materials are detailed in Table 3.3-13. As indicated in Section 3.0.5.3.3.3 (Military Expended Material Strikes), under Alternative 2, the total amount of military expended materials is more than four times the amount expended in the No Action Alternative, but only increases by 11 percent overall as compared to Alternative 1. Activities under Alternative 2 would occur in the same geographic locations as the No Action Alternative, with the exception of the introduction of activities in the Key West Range Complex. Activities using military expended materials are concentrated within VACAPES Range Complex and Naval

Surface Warfare Center, Panama City Division Testing Range. Military expended materials would typically be of the same type listed under the No Action Alternative. Species that occur in these areas, including all ESA-listed species would have the potential to be exposed to military expended material strikes.

The differences in species overlap and potential impacts of military expended material strikes on marine fish groups and ESA-listed species during testing activities would not be discernible from those described for training activities in Section 3.9.3.3.2.1 (No Action Alternative). Military expended materials hitting the water could result in an extremely unlikely strike of an individual fish, or more likely in a short-term and local displacement of fish in the water column. However, these behavioral reactions are not expected to result in substantial changes to an individual's fitness or species recruitment, and are not expected to result in population-level impacts (see Section 3.9.3.3.2.1, No Action Alternative). Similarly, military expended materials are not anticipated to affect any primary constituent elements of critical habitat for Atlantic salmon or smalltooth sawfish (see Section 3.9.3.3.2.1, No Action Alternative). Parachutes, fiber optic cables, and guidance wires would overlap critical habitat for Gulf sturgeon, but none of the primary constituent elements of Gulf sturgeon critical habitat would be affected (see discussion of the impacts from military expended materials in Section 3.9.3.3.2.1, No Action Alternative).

Alternative 2 would include a substantial increase in small-caliber projectiles. The overall increase of military expended material under Alternative 2 would result in an increase in the strike risk; however, it would not rise to the level of being a concern. The potential impacts of military expended material strikes would be short-term (seconds) and localized disturbances of the water surface (and seafloor areas within the sinking exercise box) and are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction at the population level.

Pursuant to the ESA, the use of military expended materials during testing activities as described under Alternative 2:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon;*
- *will have no effect on ESA-listed Atlantic salmon or smalltooth sawfish critical habitat; and*
- *may affect but is not likely to adversely affect critical habitat for Gulf sturgeon.*

3.9.3.3.3 Impacts from Seafloor Devices

For a discussion of the types of activities that use seafloor devices, where they are used, and how many activities would occur under each alternative, see Section 3.0.5.3.3.4 (Seafloor Devices). Seafloor devices include items placed on, dropped on, or moved along the seafloor, such as mine shapes, anchor blocks, anchors, bottom-placed instruments, bottom-crawling unmanned underwater vehicles, and bottom-placed targets that are not expended. As discussed in the military expended materials strike section, objects falling through the water column will slow in velocity as they sink toward the bottom and could be avoided by most fish.

Seafloor devices with a strike potential for fish include those items temporarily deployed on the seafloor. The potential strike impacts of bottom crawling types of unmanned underwater vehicles are also included here. Some fish are attracted to virtually any tethered object in the water column (Dempster and Taquet 2004) and could be attracted to a non-explosive mine assembly. However, while a fish might be attracted to the object, their sensory abilities allow them to avoid colliding with fixed tethered objects in the water column (Bleckmann and Zelick 2009), so the likelihood of a fish striking one of these objects is implausible. Therefore, strike hazards associated with collision into other seafloor devices such as deployed mine shapes or anchored devices are not discussed further.

3.9.3.3.3.1 No Action Alternative

Training Activities

Table 3.0-76 lists the number and location of activities that use seafloor devices. As indicated in Section 3.0.5.3.3.4 (Seafloor Devices), under the No Action Alternative, training activities that deploy seafloor devices occur in the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems and the Gulf Stream Open Ocean Area—specifically within the Northeast, VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes.

Seafloor devices are not expected to cause disturbance to any species other than bottom-dwelling fish; therefore, under the No Action Alternative, seafloor devices are not likely to impact any ESA-listed species. In addition, seafloor devices are not anticipated to affect any primary constituent elements of critical habitat for Atlantic salmon, smalltooth sawfish, or Gulf sturgeon. Activities that employ these devices do not overlap the critical habitat of the Atlantic salmon, smalltooth sawfish, and Gulf sturgeon.

Pursuant to the ESA, the use of seafloor devices during training activities as described under the No Action Alternative:

- *will have no effect on ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon; and*
- *will have no effect on Atlantic salmon, smalltooth sawfish, or Gulf sturgeon critical habitat.*

Testing Activities

Table 3.0-76 lists the number and location of activities that use seafloor devices. As indicated in Section 3.0.5.3.3.4 (Seafloor Devices), under the No Action Alternative, testing activities that use seafloor devices occur in the Gulf of Mexico, Northeast, and Southeast U.S. Continental Shelf Large Marine Ecosystems as well as Gulf Stream Open Ocean Area—specifically within the VACAPES Range Complex; Naval Undersea Warfare Center Division, Newport Testing Range; and Naval Surface Warfare Center, Panama City Division Testing Range.

As discussed in Section 3.9.3.3.2 (Impacts from Military Expended Material), objects falling through the water column will slow in velocity as they sink toward the bottom and could be avoided by most fish. The only seafloor device used during testing activities that has the potential to strike a fish within the water column are aircraft deployed mine shapes, which are deployed at the surface during aerial mine laying in the VACAPES Range Complex. Atlantic salmon, largetooth sawfish, and Gulf sturgeon do not occur where aerial mine laying activities take place. The impacts of these devices on Atlantic sturgeon, shortnose sturgeon, and smalltooth sawfish are identical to non-explosive practice bombs discussed in the analysis of potential impacts in the military expended material strike section. These devices would not be used where ESA-listed Atlantic salmon, largetooth sawfish, or Gulf sturgeon occur. Similarly, these devices are not anticipated to affect any primary constituent elements of critical habitat for Atlantic salmon, smalltooth sawfish, or Gulf sturgeon (see discussion of the impacts from military expended materials in Section 3.9.3.3.2.1, No Action Alternative).

Pursuant to the ESA, the use of seafloor devices during testing activities as described under the No Action Alternative:

- *will have no effect on ESA-listed Atlantic salmon, largetooth sawfish, or Gulf sturgeon;*
- *may affect but is not likely to adversely affect the ESA-listed smalltooth sawfish, Atlantic sturgeon, or shortnose sturgeon; and*
- *will have no effect on Atlantic salmon, smalltooth sawfish, or Gulf sturgeon critical habitat.*

3.9.3.3.3.2 Alternative 1

Training Activities

Training activities that deploy seafloor devices under Alternative 1 would occur in the same geographic areas as under the No Action Alternative and are expected to increase by 44 percent. Seafloor devices are not expected to cause disturbance to any species other than bottom-dwelling fish; therefore, under the No Action Alternative, seafloor devices are not likely to impact any ESA-listed species. In addition, seafloor devices are not anticipated to affect any primary constituent elements of critical habitat for Atlantic salmon, smalltooth sawfish, or Gulf sturgeon.

Pursuant to the ESA, the use of seafloor devices during training activities as described under Alternative 1:

- *will have no effect on ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon; and*
- *will have no effect on Atlantic salmon, smalltooth sawfish, or Gulf sturgeon critical habitat.*

Testing Activities

Table 3.0-76 lists the number and location of activities that use seafloor devices. As indicated in Section 3.0.5.3.3.4 (Seafloor Devices), under Alternative 1, the number of activities using seafloor devices is approximately twice that of the No Action Alternative. The activities using seafloor devices under Alternative 1 would occur in the same geographic locations as the No Action Alternative. In addition, seafloor devices would be used in the South Florida Ocean Measurement Facility Testing Range; Northeast, Navy Cherry Point, and JAX Range Complexes; and throughout the Gulf of Mexico.

As discussed in Section 3.9.3.3.2 (Impacts from Military Expended Material), objects falling through the water column will slow in velocity as they sink toward the bottom and could be avoided by most fish. The only seafloor device used during testing activities that has the potential to strike a fish within the water column is an aircraft deployed mine shape, which is deployed at the surface during aerial mine laying in the VACAPES and JAX Range Complexes. Atlantic salmon, largetooth sawfish, and Gulf sturgeon do not occur where aerial mine laying activities take place. These devices are identical to non-explosive practice bombs and the potential impacts are included in the analysis of potential impacts on Atlantic sturgeon, shortnose sturgeon, and smalltooth sawfish within the military expended material strike section. Seafloor devices are not anticipated to affect any primary constituent elements of critical habitat for Atlantic salmon, smalltooth sawfish, or Gulf sturgeon for the same reasons identified for military expended materials strike (see discussion of the impacts from military expended materials in Section 3.9.3.3.2.1 [No Action Alternative]).

Pursuant to the ESA, the use of seafloor devices during testing activities as described under Alternative 1:

- *will have no effect on ESA-listed Atlantic salmon, largetooth sawfish, or Gulf sturgeon;*
- *may affect but is not likely to adversely affect the ESA-listed smalltooth sawfish, Atlantic sturgeon, or shortnose sturgeon; and*
- *will have no effect on Atlantic salmon, smalltooth sawfish, or Gulf sturgeon critical habitat.*

3.9.3.3.3.3 Alternative 2 (Preferred Alternative)

Training Activities

The number and location of training activities under Alternative 2 are identical to training activities under Alternative 1. Therefore, impacts and comparisons to the No Action Alternative will also be identical as described in Section 3.9.3.3.3.2 (Alternative 1).

Pursuant to the ESA, the use of seafloor devices during training activities as described under Alternative 2:

- *will have no effect on ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon; and*
- *will have no effect on Atlantic salmon, smalltooth sawfish, or Gulf sturgeon critical habitat.*

Testing Activities

Table 3.0-76 lists the number and location where seafloor devices are used. As indicated in Section 3.0.5.3.3.4 (Seafloor Devices), under Alternative 2, the number of activities using seafloor devices is approximately twice that of the No Action Alternative. The activities using seafloor devices under Alternative 2 would occur in the same geographic locations as the No Action Alternative. In addition, seafloor devices would be used in the Northeast, Navy Cherry Point, and JAX Range Complexes as well as throughout the Gulf of Mexico.

As discussed in Section 3.9.3.3.2 (Impacts from Military Expended Material), objects falling through the water column will slow in velocity as they sink toward the bottom and could be avoided by most fish. The only seafloor device used during testing activities that has the potential to strike a fish within the water column is an aircraft deployed mine shape, which is deployed at the surface during aerial mine laying (in the VACAPES and JAX Range Complexes). Atlantic salmon, largetooth sawfish, and Gulf sturgeon do not occur where aerial mine laying activities take place. These devices are identical to non-explosive practice bombs and the potential impacts are included in the analysis of potential impacts on Atlantic sturgeon, shortnose sturgeon, and smalltooth sawfish within the military expended material strike section. Seafloor devices are not anticipated to affect any primary constituent elements of critical habitat for Atlantic salmon, smalltooth sawfish, or Gulf sturgeon for the same reasons identified for military expended materials strike (see discussion of the impacts from military expended materials in Section 3.9.3.3.2.1 [No Action Alternative]).

Pursuant to the ESA, the use of seafloor devices during testing activities as described under Alternative 2:

- *will have no effect on ESA-listed Atlantic salmon, largetooth sawfish, or Gulf sturgeon;*
- *may affect but is not likely to adversely affect the ESA-listed smalltooth sawfish, Atlantic sturgeon, or shortnose sturgeon; and*
- *will have no effect on Atlantic salmon, smalltooth sawfish, or Gulf sturgeon critical habitat.*

3.9.3.4 Entanglement Stressors

This section evaluates potential entanglement impacts of various types of expended materials used by the Navy during training and testing activities within the Study Area. The likelihood of fish being affected by an entanglement stressor is a function of the physical properties, location, and buoyancy of the object and the behavior of the fish as described in Section 3.0.5.7.4 (Conceptual Framework for Assessing Effects from Entanglement). Two types of military expended materials are considered here: (1) cables and wires, and (2) parachutes.

Most entanglement observations involve abandoned or discarded nets, lines, and other materials that form loops or incorporate rings (Derraik 2002; Keller et al. 2010; Laist 1987; Macfadyen et al. 2009). A 25-year dataset assembled by the Ocean Conservancy reported that fishing line, rope, and fishing nets accounted for 68 percent of fish entanglements, with the remainder due to encounters with various items such as bottles, cans, and plastic bags (Ocean Conservancy 2010b). No occurrences involving military expended materials were documented.

Fish entanglement occurs most frequently at or just below the surface or in the water column where objects are suspended. A smaller number involve objects on the seafloor, particularly abandoned fishing gear designed to catch bottom fish or invertebrates (Ocean Conservancy 2010b). More fish species are entangled in coastal waters and the continental shelf than elsewhere in the marine environment because of higher concentrations of human activity (e.g., fishing, sources of entangling debris), higher fish abundances, and greater species diversity (Helfman et al. 2009; Macfadyen et al. 2009). The consequences of entanglement range from temporary and inconsequential to major physiological stress or mortality.

Some fish are more susceptible to entanglement in derelict fishing gear and other marine debris, compared to other fish groups. Physical features, such as rigid or protruding snouts of sawfish and sturgeon and some elasmobranchs (e.g., the wide heads of hammerhead sharks), increase the risk of entanglement compared to fish with smoother, more streamlined bodies (e.g., lamprey and eels). Sawfish occur only in nearshore, and coastal waters of the Gulf of Mexico Large Marine Ecosystem and very limited portions of the Southeast U.S. Continental Shelf Large Marine Ecosystem (FR 74 (169): 45353-45359, September 2, 2009; FR 74 (144): 37671-37674, July 29, 2009), where they are concentrated in south Florida and the Florida Keys. Scalloped hammerhead sharks and each ESA-listed sturgeon species occurs in each of the large marine ecosystems that overlap Navy training and testing areas in the Study Area, within nearshore and offshore waters. Most other fish, except for jawless fish and eels that are too smooth and slippery to become entangled, are susceptible to entanglement gear specifically designed for that purpose (e.g., gillnets); however, the Navy does not expend any items that are designed to function as entanglement objects.

The overall impacts of entanglement are highly variable, ranging from temporary disorientation to mortality due to predation or physical injury. The evaluation of a species' entanglement potential should consider the size, location, and buoyancy of an object as well as the behavior of the fish species.

The following sections seek to identify entanglement potential due to military expended material. Where appropriate, specific geographic areas (large marine ecosystems, open ocean areas, range complexes, testing ranges, and bays and inland waters) of potential impact are identified.

3.9.3.4.1 Impacts from Fiber Optic Cables and Guidance Wires

Fiber optic cables and guidance wires are used during training and testing activities. A discussion of the types of activities, physical characteristics, location of use, and the number of items expended under each alternative is presented in Sections 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires).

Once a guidance wire is released, it is likely to sink immediately and remain on the seafloor. In some cases, the wire may snag on a hard structure near the bottom and remain partially or completely suspended. The types of fish that encounter any given wire would depend, in part, on its geographic location and vertical location in the water column. In any situation, the most likely mechanism for entanglement would involve fish swimming through loops in the wire that tighten around it; however, loops are unlikely to form in guidance wire (Environmental Sciences Group 2005).

Because of their physical characteristics, guidance wires and fiber optic cables pose a potential, though unlikely, entanglement risk to susceptible fish. Potential entanglement scenarios are based on fish behavior in abandoned monofilament, nylon, and polypropylene lines used in commercial nets. Such derelict fishing gear is abundant in the ocean (Macfadyen et al. 2009) and pose a greater hazard to fish than the very thin wire expended by the Navy. Fishing gear materials often have breaking strengths that can be up to orders of magnitude greater than that of guidance wire and fiber optic cables (Environmental Sciences Group 2005), and are far more prone to tangling, as discussed in 3.0.5.3.4.1, Fiber Optic Cables and Guidance Wires. Fiber optic cables do not easily form loops, are brittle, and break easily if bent, so they pose a negligible entanglement risk. Additionally, the encounter rate and probability of impact from guidance wires and fiber optic cables are low, as few are expended and therefore, have limited overlap with sawfish or sturgeon.

Tube-launched optically tracked wire-guided missiles would expend wires in the nearshore or offshore waters of the Navy Cherry Point Range Complex, during training only and are discussed together with torpedo guidance wires because their potential impacts would be similar to those described here for torpedo guidance wires, which are also expended in the Navy Cherry Point Range Complex.

3.9.3.4.1.1 No Action Alternative

Training Activities

Tables 3.0-86 and 3.0-89 list the number and locations of activities that expend fiber optic cables and guidance wires. As indicated in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires), under the No Action Alternative, activities that expend fiber optic cables occur in the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems as well as the Gulf Stream and North Atlantic Gyre Open Ocean Areas— specifically within the VACAPES, Navy Cherry Point, and JAX Range Complexes. The area that will have the greatest concentration of expended cables or wires is within the VACAPES Range Complex (specifically W-50). W-50 includes 123 square nautical miles (nm^2) of sea space. Under the No Action Alternative, there would be approximately six cables per nm^2 if they were expended evenly throughout the area.

Torpedoes expending guidance wire would occur in the Northeast and Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems as well as the Gulf Stream and North Atlantic Gyre Open Ocean Areas—specifically within the Northeast, VACAPES, Navy Cherry Point, and JAX Range Complexes. The greatest concentration would occur in the JAX Range Complex, but guidance wires could also be expended outside the range complexes—specifically the sinking exercise box and anywhere in the Gulf of Mexico portion of the Study Area.

Marine fish groups identified in Sections 3.9.2 (Affected Environment), that could be susceptible to entanglement in expended cables and wires are those with elongated snouts lined with tooth-like structures that easily snag on other similar marine debris, such as derelict fishing gear (Macfadyen et al. 2009). Some elasmobranchs (sawfish and hammerhead sharks), sturgeon, and billfish occurring within the offshore and continental shelf portions of the range complexes (where the potential for entanglement would occur) could be susceptible to entanglement in cables and wires. Atlantic salmon would not be as prone to entanglement because they do not possess the morphological features (rigid or protruding snouts) associated with high entanglement rates. Species occurring outside the specified areas within these range complexes would not be exposed to fiber optic cables or guidance wires.

The locations of expended cables and wires overlap the range for all of the ESA-listed fish, with the exception of Atlantic salmon. Smalltooth sawfish and largetooth sawfish are vulnerable to entanglement in the JAX and GOMEX Range Complexes due to elongated snouts lined with tooth-like structures that easily snag on fishing gear and other marine debris (Macfadyen et al. 2009; Seitz and Poulakis 2006; Simpfendorfer and Wiley 2006). However, the likelihood of a sawfish encountering expended wires and cables in these locations is low because of the low density in which they are expended.

The entanglement potential of discarded sections of fiber optic cable is low due to the brittle nature of the cable, which is easily broken when kinked, twisted, or bent sharply. The physical properties of the fiber optic cable prevent it from forming loops, greatly reducing or even eliminating the risk to fish (U.S. Department of the Navy 2001a). Additionally, encounter rates with fiber optic cables is limited by the small number that are expended.

Atlantic and shortnose sturgeon could encounter fiber optic cables in the VACAPES, Navy Cherry Point, or JAX Range Complexes; smalltooth sawfish could occur in the JAX Range Complex as well. For sawfish, early life stages have the same body-type as adults. However, the likelihood of entanglement of early life stages would be slightly less than that of adults, because nursery habitats are found in very shallow water (less than 1 m) (National Marine Fisheries Service 2009c), where no cables or wires would be expended. Early life stages of sturgeon and Atlantic salmon are typically (or exclusively, for salmon) found in freshwater rivers and not in marine environments, so only juveniles and adults would be potentially exposed to entanglement stressors. Gulf sturgeon would not encounter fiber-optic cables because none are expended during training activities in the Gulf of Mexico. In the rare instance where a fish did encounter a fiber optic cable, entanglement is unlikely because the cable is not strong enough to bind most fish (U.S. Department of the Navy 2001a).

Guidance wire would not be expended within the inshore or nearshore habitats of either smalltooth or largetooth sawfish in the Other AFTT Areas. Any of the ESA-listed sturgeon species could encounter guidance wire because they can occur in nearshore waters out to the shelf break, where they feed on the bottom and could become entangled in a guidance wire while feeding. However, sturgeon are more commonly found closer to shore, where they would be less likely to encounter any guidance wire.

Guidance wires sink too quickly to be transported very far before reaching the seafloor (Environmental Sciences Group 2005). Fish would rarely encounter guidance wires expended during training activities. If a guidance wire were encountered, the most likely result would be that the fish ignores it, which is an inconsequential and immeasurable effect. In the rare instance where an individual fish became entangled in guidance wire and could not break free, the individual could be impacted as a result of impaired feeding, bodily injury, or increased susceptibility to predators. However, this is an extremely unlikely scenario because the density of guidance wires would be very low, as discussed in Section 3.0.5.3.4.1 (Fiber Optic Cable and Guidance Wires).

While individual fish susceptible to entanglement could encounter guidance wires and cables, the long-term consequences of entanglement are unlikely for either individuals or populations because (1) the encounter rate is low given the low number of items expended, (2) the types of fish that are susceptible to these items is limited, (3) the restricted overlap with susceptible fish, and (4) the properties of guidance wires and fiber optic cables reduce entanglement risk to fish. Potential impacts of exposure to guidance wires and fiber optic cables are not expected to result in substantial changes to an individual's behavior, fitness, or species recruitment, and are not expected to result in population-level impacts.

Pursuant to the ESA, the use of fiber optic cables and guidance wires during training activities as described under the No Action Alternative:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon.*

Testing Activities

Tables 3.0-86 and 3.0-89 list the number and locations of activities that expend fiber optic cables and guidance wires. As indicated in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires), under the No Action Alternative, activities that expend fiber optic cables would occur in the Northeast and Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems as well as the Gulf Stream Open Ocean Area—specifically within the VACAPES Range Complex and Naval Surface Warfare Center, Panama City Division Testing Range. Torpedoes expending guidance wire would occur in the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems as well as the Gulf Stream Open Ocean Area—specifically within the Northeast, VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes. Under the No Action Alternative, there would be approximately one cable per 17 nm^2 if they were expended evenly throughout these areas. Guidance wire could also be expended outside the range complexes—specifically the sinking exercise box.

The differences in species overlap and potential impacts of military expended material strikes on marine fish groups and ESA-listed species during testing activities would not be discernible from those described in Section 3.9.3.4.1.1 (No Action Alternative). Atlantic salmon would not be as prone to entanglement because they do not possess the morphological features (rigid or protruding snouts) associated with high entanglement rates. ESA-listed species susceptible to entanglement (sawfish and sturgeon species) and those not susceptible to entanglement (Atlantic salmon) occur in testing locations, but are unlikely to encounter the guidance wires because of their low densities in the areas where they are expended. Early life stages of sturgeon and Atlantic salmon are typically (or exclusively, for salmon) found in freshwater rivers and not in marine environments, so only juveniles and adults would be potentially exposed to entanglement stressors. For sawfish, the early life stages have the same body-type as adults; however, the likelihood of entanglement of early life stages would be slightly less than that of adults, because nursery habitats are found in very shallow water (less than 1 m), where no cables or wires would be expended.

The risk of entanglement resulting from proposed testing activities that expend cables and wires would be low as described in training activities for the No Action Alternative. While individual fish susceptible to entanglement could encounter guidance wires and cables, the long-term consequences of entanglement are unlikely for either individuals or populations because (1) the encounter rate is low given the low number of items expended, (2) the types of fish that are susceptible to these items is limited, (3) the restricted overlap with susceptible fish, and (4) the properties of guidance wires and fiber optic cables reduce entanglement risk to fish. Potential impacts of exposure to guidance wires and fiber optic cables are not expected to result in substantial changes to an individual's behavior, fitness, or species recruitment, and are not expected to result in population-level impacts.

Pursuant to the ESA, the use of fiber optic cables and guidance wires during testing activities as described under the No Action Alternative:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon.*

3.9.3.4.1.2 Alternative 1

Training Activities

Tables 3.0-86 and 3.0-89 list the number and locations of activities that expend fiber optic cables and guidance wires. As indicated in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires) under Alternative 1, activities that expend fiber optic cables is more than three times that of the No Action Alternative. These activities would occur in the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems as well as the Gulf Stream and North Atlantic Gyre Open Ocean Areas— specifically within the VACAPES, Cherry Point, and JAX Range Complexes. This would result in a maximum concentration of approximately one cable per 16 nm^2 if they were expended evenly throughout the area.

The number of torpedo activities that expend guidance wire would increase by 21 percent under Alternative 1 and would occur in the same geographic locations as the No Action Alternative, with the exception of introducing guidance wires in the Other AFTT Areas while vessels are in transit.

The differences in species overlap and potential impacts of fiber optic cables and guidance wires on marine fish groups and ESA-listed species during training activities would not be discernible from those described in Section 3.9.3.4.1.1 (No Action Alternative). ESA-listed species susceptible to entanglement (sawfish and sturgeon species) and those not as susceptible to entanglement (Atlantic salmon) occur in the general vicinity of the training, but are unlikely to encounter guidance wires because of the low density in areas where they are expended. For reasons stated in the No Action Alternative, the risk of entanglement resulting from proposed training activities that expend cables and wires would be low and are not expected to result in long-term impacts beyond behavioral disturbance.

While individual fish susceptible to entanglement could encounter guidance wires and fiber optic cables, the long-term consequences of entanglement are unlikely for either individuals or populations because (1) the encounter rate is low given the low number of items expended, (2) the types of fish that are susceptible to these items is limited, (3) the restricted overlap with susceptible fish, and (4) the properties of guidance wires and fiber optic cables reduce entanglement risk to fish. Potential impacts of exposure to guidance wires and fiber optic cables are not expected to result in substantial changes to an individual's behavior, fitness, or species recruitment, and are not expected to result in population-level impacts.

Pursuant to the ESA, the use of fiber optic cables and guidance wires during training activities as described under Alternative 1:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon.*

Testing Activities

Tables 3.0-86 and 3.0-89 list the number and locations of activities that expend fiber optic cables and guidance wires. As indicated in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires) under Alternative 1, activities that expend fiber optic cables is more than two times that of the No Action Alternative. These activities would occur in the same geographic locations as the No Action Alternative with the exception of adding activities within the Gulf of Mexico. This would result in a maximum concentration of approximately one cable per 7 nm^2 if they were expended evenly throughout the area.

The number of torpedo activities that expend guidance wire is more than six times that of the No Action Alternative and occur in the same geographic locations as the No Action Alternative, with the exception of introducing guidance wires in the Gulf of Mexico portion of the Study Area.

The differences in species overlap and potential impacts of fiber optic cables and guidance wire on marine fish groups and ESA-listed species during testing activities would not be discernible from those described in Section 3.9.3.4.1.1 (No Action Alternative). ESA-listed species susceptible to entanglement (sawfish and sturgeon species) and those not as susceptible to entanglement (Atlantic salmon) occur in testing locations, but are unlikely to encounter the guidance wires because their densities are low in the areas where they are expended. The risk of entanglement resulting from proposed testing activities that expend cables and wires would be low and are not expected to result in long-term impacts beyond behavioral disturbance, as described in testing activities for the No Action Alternative (Section 3.9.3.4.1.1, No Action Alternative).

The risk of entanglement resulting from proposed testing activities that expend cables and wires would be low as described in training activities for the No Action Alternative. While individual fish susceptible to entanglement could encounter guidance wires and cables, consequences of entanglement are unlikely for either individuals or populations because (1) the encounter rate is low given the low number of items expended, (2) the types of fish that are susceptible to these items is limited, (3) the restricted overlap with susceptible fish, and (4) the properties of guidance wires and fiber optic cables reduce entanglement risk to fish. Potential impacts of exposure to guidance wires and fiber optic cables are not expected to result in substantial changes to an individual's behavior, fitness, or species recruitment, and are not expected to result in population-level impacts.

Pursuant to the ESA, the use of fiber optic cables and guidance wires during testing activities as described under Alternative 1:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon.*

3.9.3.4.1.3 Alternative 2 (Preferred Alternative)

Training Activities

The number and location of training activities under Alternative 2 are identical to training activities under Alternative 1. Therefore, impacts and comparisons to the No Action Alternative will also be identical as described in Section 3.9.3.4.1.2 (Alternative 1).

Pursuant to the ESA, the impacts from the use of fiber optic cables and guidance wires during training activities as described under Alternative 2:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon.*

Testing Activities

Tables 3.0-86 and 3.0-89 list the number and locations of activities that expend fiber optic cables and guidance wires. As indicated in Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires) under Alternative 2, the number of activities that expend fiber optic cables is 2.5 times higher than that of the No Action Alternative, but only increases by 17 percent as compared to Alternative 1. The activities using fiber optic cables under Alternative 2 would occur in the same geographic locations as the No Action Alternative. This would result in a maximum concentration of approximately one cable per 7 nm^2 if they were expended randomly in this area.

The number of torpedo activities that expend guidance wire is approximately seven times that of the No Action Alternative and results in an increase of 13 percent when compared to Alternative 1. These activities under Alternative 2 would occur in the same geographic locations as the No Action Alternative, with the exception of introducing guidance wires in the Gulf of Mexico portion of the Study Area.

The differences in species overlap and potential impacts of fiber optic cables and guidance wires on marine fish groups and ESA-listed species during testing activities would not be discernible from those described in Section 3.9.3.4.1.1 (No Action Alternative). ESA-listed species susceptible to entanglement (sawfish and sturgeon species) and those not as susceptible to entanglement (Atlantic salmon) occur in testing locations, but are unlikely to encounter guidance wires because their densities are low in the areas where they are expended. The risk of entanglement resulting from proposed testing activities would be low and are not expected to result in long-term impacts beyond behavioral disturbance, as described in Section 3.9.3.4.1.1 (No Action Alternative).

The risk of entanglement resulting from proposed testing activities that expend cables and wires would be low as described in training activities for the No Action Alternative. While individual fish susceptible to entanglement could encounter guidance wires and fiber optic cables, the long-term consequences of entanglement are unlikely for either individuals or populations. because (1) the encounter rate is low given the low number of items expended, (2) the types of fish that are susceptible to these items is limited, (3) the restricted overlap with susceptible fish, and (4) the properties of guidance wires and fiber optic cables reduce entanglement risk to fish. Potential impacts of exposure to guidance wires and fiber optic cables are not expected to result in substantial changes to an individual’s behavior, fitness, or species recruitment, and are not expected to result in population-level impacts.

Pursuant to the ESA, the use of fiber optic cables and guidance wires during testing activities as described under Alternative 2:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon.*

3.9.3.4.2 Impacts from Parachutes

Parachutes of varying sizes are used during training and testing activities. The physical characteristics and size of parachutes are presented in Section 3.0.5.3.4.2 (Parachutes). The types of activities that use parachutes are listed in Tables 3.0-58 and 3.0-59. The estimated number of parachutes and locations where they would be expended are detailed in Table 3.0-73.

Fish face many potential entanglement scenarios in abandoned monofilament, nylon, polypropylene line, and other derelict fishing gear in the nearshore and offshore marine habitats of the Study Area (Macfadyen et al. 2009; Ocean Conservancy 2010b). Abandoned fishing gear is dangerous to fish because it is abundant, essentially invisible, strong, and easily tangled. In contrast, parachutes are rare, highly visible, and not designed to capture fish. The combination of low encounter rates and weak entangling features reduce the risk that sawfish and other ESA-protected fish would be adversely impacted by parachutes.

Once a parachute has been released to the water, it poses a potential entanglement risk to fish. The Naval Ocean Systems Center identified the potential impacts of torpedo air launch accessories, including parachutes, on fish (U.S. Department of the Navy 1996). Unlike other materials in which fish become entangled (such as gill nets and nylon fishing line), the parachute is relatively large and visible, reducing the chance that visually oriented fish would accidentally become entangled in it. No cases of fish entanglement have been reported for parachutes (Ocean Conservancy 2010b; U.S. Department of the Navy 2001a). Entanglement in a newly expended parachute while it is in the water column is unlikely because fish generally react to sound and motion at the surface with a behavioral reaction by swimming away from the source (see Section 3.9.3.3.2, Impacts from Military Expended Material) and would detect the oncoming parachute in time to avoid contact. While the parachute is sinking, fish would have ample opportunity to swim away from the large moving object. Even if the parachute landed directly on a fish, it would likely be able to swim away faster than the parachute would sink because the resistance of the water would slow the parachute's downward motion.

Once the parachute is on the bottom, however, it is feasible that a fish could become entangled in the parachute or its suspension lines while diving and feeding, especially in deeper waters where it is dark. If the parachute dropped in an area of strong bottom currents, it could billow open and pose a short-term entanglement threat to large fish feeding on the bottom. Benthic fish with elongated spines could become caught on the parachute or lines. Most sharks and other smooth-bodied fish are not expected to become entangled because their soft, streamlined bodies can more easily slip through potential snares. A fish with spines or protrusions (e.g., some sharks, billfish, sturgeon, or sawfish) on its body that swam into the parachute or a loop in the lines, and then struggled, could become bound tightly enough to prevent escape. Although this scenario is possible based on the structure of the materials and the shape and behavior of fish, it is not considered a likely event.

Aerial-launched sonobuoys are deployed with a parachute. The sonobuoy itself is not considered an entanglement hazard for upon deployment (Environmental Sciences Group 2005), but their components may pose an entanglement hazard once released into the ocean. Sonobuoys contain cords, electronic components, and plastic mesh that may entangle fish (Environmental Sciences Group 2005). Open-ocean filter feeding species, such as basking sharks, whale sharks, and manta rays could become entangled in these items, whereas smaller species such as Atlantic herring could become entangled in the plastic mesh in the same manner as a small gillnet. The sonobuoy canister is similar in diameter to a coffee can, which is a known entanglement risk to the smalltooth sawfish; these fish have been found with a plastic pipe or coffee can encircling their snouts, which can interfere with their feeding (Seitz and Poulakis 2006). A smalltooth sawfish could get its snout lodged inside a sonobuoy canister in this same manner. Since most sonobuoys are expended in offshore areas, many coastal fish would not encounter or have any opportunity to become entangled in materials associated with sonobuoys, apart from the risk of entanglement in parachutes described above.

3.9.3.4.2.1 No Action Alternative

Training Activities

Table 3.0-73 lists the number and locations of activities that expend parachutes. The number and footprint of parachutes are detailed in Table 3.3-9. As indicated in Table 3.0-73 under the No Action Alternative, activities involving parachute use would occur in the Northeast and Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems as well as the Gulf Stream and North Atlantic Gyre Open Ocean Areas—specifically within the Northeast, VACAPES, Navy Cherry Point, JAX, Key West, and GOMEX Range Complexes. To estimate a worst-case scenario, calculations were made for the area where parachutes would be expended with greatest concentration. For training events, the greatest concentration would occur in the Southeast U.S. Continental Shelf Large Marine Ecosystem and Gulf Stream Open Ocean Area (specifically, the JAX Range Complex). Under the No Action Alternative, there would be a concentration of approximately one parachute per 2 nm^2 if they were evenly expended throughout the area. Species that occur in these areas, including all ESA-listed species would have the potential to be exposed to parachutes.

Marine fish groups identified in Section 3.9.2 (Affected Environment) that could be susceptible to entanglement in parachutes are the same as discussed for cables and wires in Section 3.9.3.4.1.1 (No Action Alternative). Some elasmobranchs (sawfish, hammerhead sharks), sturgeon, and billfish occurring within the offshore and continental shelf portions of the range complexes (where the potential for entanglement would occur) could be susceptible to entanglement in parachutes. As described above, the highly maneuverable swimming capabilities of these fish make it unlikely that any entanglement would occur while the parachutes are at the surface or sinking through the water column. Sawfish are not expected to co-occur with newly expended parachutes, as these ESA-protected fish remain primarily nearshore and close to the bottom, particularly in shallow areas where parachutes are not expended. It is conceivable that a sawfish or sturgeon could encounter an expended parachute that has settled to the bottom. Any of the sturgeon species could encounter parachutes because sturgeon can occur at the surface or on the bottom in nearshore waters out to the shelf break. However, the ESA-listed sturgeon are more commonly found closer to shore, where they would be less likely to encounter any parachutes.

The Atlantic salmon occurs in offshore areas where parachutes would be expended in the Northeast Range Complexes and may encounter parachutes in the water column. However, the Atlantic salmon, like all salmonids, is a strong swimmer with a streamlined body that is unlikely to become entangled in parachutes or lines. The impacts of entanglement with parachutes are discountable because of the low density of parachutes expended in this location and the body shape of Atlantic salmon, which makes it unlikely to become entangled. Potential impacts on smalltooth sawfish and largetooth sawfish would be discountable because of the low density of parachutes that would co-occur with sawfish habitat. The largetooth sawfish is particularly rare in the Study Area, even for an endangered species (the last confirmed records of largetooth sawfish in U.S. waters were from Port Aransas, Texas in 1961, Florida in 1941, and Louisiana in 1917 (FR 76 (133): 40822-40836, July 12, 2011).

In addition to the low concentration of parachutes expended in areas where sawfish might occur, sawfish are highly mobile, visual predators that could easily avoid a floating or suspended parachute. If a rare parachute encounter by a sawfish led to entanglement, the fish would likely thrash its rostral saw in an effort to break free. If such an effort were unsuccessful, the individual could remain entangled, possibly resulting in injury or death. However, this scenario is considered so unlikely that it would be discountable.

For sawfish, the early life stages have the same body-type as adults; however, the likelihood of entanglement of early life stages would be slightly less than that of adults, because nursery habitats are found in very shallow water (less than 1 m) (National Marine Fisheries Service 2009c), where no parachutes would be expended. Early life stages of sturgeon and Atlantic salmon are typically (or exclusively, for salmon) found in freshwater rivers and not in marine environments, so only juveniles and adults would be potentially exposed to entanglement stressors.

Fish are unlikely to encounter or become entangled in parachutes because of the large size of the range complexes and the resulting widely scattered expended parachutes. Individual fish are not prone to be repeatedly exposed to parachutes, thus the long-term consequences of entanglement risks from parachutes are unlikely for either individuals or populations.

Pursuant to the ESA, the use of parachutes during training activities as described under the No Action Alternative:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon.*

Testing Activities

Table 3.0-73 lists the number and locations of activities that expend parachutes. The number and footprint of parachutes are detailed in Table 3.3-10. As indicated in Table 3.0-73 under the No Action Alternative, activities involving parachute use would occur in the Northeast and Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems as well as the Gulf Stream and North Atlantic Gyre Open Ocean Areas—specifically within the Northeast, VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes and in the SINKEX Box outside the range complexes. To estimate a worst-case scenario, calculations were made for the area where parachutes would be expended with greatest concentration. For testing events, the greatest concentration would occur in the Northeast U.S. Continental Shelf Large Marine Ecosystem and the Gulf Stream Open Ocean Area (specifically, in the VACAPES Range Complex). Under the No Action Alternative, there would be a concentration of approximately one parachute per 22 nm^2 if the parachutes were expended evenly throughout the area. Species that occur in these areas, including all ESA-listed species would have the potential to be exposed to parachutes.

Marine fish groups identified in Section 3.9.2 (Affected Environment) that could be susceptible to entanglement in parachutes are the same as discussed for cables and wires in Section 3.9.3.4.1.1 (No Action Alternative). It is conceivable that a sawfish or sturgeon could encounter an expended parachute that has settled to the bottom. Any of the sturgeon species could encounter parachutes because sturgeon can occur at the surface or on the bottom in nearshore waters out to the shelf break. However, the ESA-listed sturgeon are more commonly found closer to shore, where they would be less likely to encounter any parachutes. For sawfish, the early life stages have the same body-type as adults; however, the likelihood of entanglement of early life stages would be slightly less than that of adults, because nursery habitats are found in very shallow water (less than 1 m), where no parachutes would be expended. Early life stages of sturgeon and Atlantic salmon are typically (or exclusively, for salmon) found in freshwater rivers and not in marine environments, so only juveniles and adults would be potentially exposed to entanglement stressors. For the reasons stated in Section 3.9.3.4.2.1 (No Action Alternative), impacts on Atlantic salmon, smalltooth sawfish, and largetooth sawfish would be discountable.

Fish are unlikely to encounter or become entangled in parachutes because of the large size of the range complexes and testing ranges and the resulting widely scattered expended parachutes. Individual fish are not prone to be repeatedly exposed to parachutes, thus the long-term consequences of entanglement risks from parachutes are unlikely for either individuals or populations.

Pursuant to the ESA, the use of parachutes during testing activities as described under the No Action Alternative:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon.*

3.9.3.4.2.2 Alternative 1

Training Activities

Table 3.0-73 lists the number and locations of activities that expend parachutes. The number and footprint of parachutes are detailed in Table 3.3-11. As indicated in Table 3.0-73 under Alternative 1 the number of activities involving the use of parachutes are 5 percent higher than that of the No Action Alternative. In addition to the geographic locations identified in the No Action Alternative, parachutes would also be expended in the Key West and GOMEX Range Complexes. Under Alternative 1, there would be a concentration of approximately one parachute per 2 nm^2 if the parachutes were expended evenly throughout the area. Species that occur in these areas, including all ESA-listed species would have the potential to be exposed to parachutes.

Marine fish groups identified in Section 3.9.2 (Affected Environment) and ESA-listed species that could be susceptible to entanglement in parachutes are the same as discussed for cables and wires in Section 3.9.3.4.2.1 (No Action Alternative). For the reasons stated in Section 3.9.3.4.2.1 (No Action Alternative), impacts on Atlantic salmon, smalltooth sawfish, and largetooth sawfish would be discountable.

Under Alternative 1 only one sonobuoy would be deployed per 32 nm^2 in the area of highest concentration. The parachute encounter rate for the smalltooth sawfish would be extremely low. In addition, sawfish are highly mobile, visual predators that could easily avoid a floating or suspended parachute. If a rare parachute encounter by a sawfish led to entanglement, the fish would likely thrash its rostral saw in an effort to break free. If such an effort were unsuccessful, the individual could remain entangled, possibly leading to injury or death. However, this scenario is so unlikely that it would be discountable because of the low density of parachutes expended in the Study Area. The risk of entanglement of sawfish from proposed training activities under Alternative 1 is low.

Fish are unlikely to encounter or become entangled in parachutes because of the large size of the range complexes and the resulting widely scattered expended parachutes. Individual fish are not prone to be repeatedly exposed to parachutes, thus the long-term consequences of entanglement risks from parachutes are unlikely for either individuals or populations.

Pursuant to the ESA, the use of parachutes during training activities as proposed under Alternative 1:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon.*

Testing Activities

Table 3.0-73 lists the number and locations of activities that expend parachutes. The number and footprint of parachutes are detailed in Table 3.3-12. As indicated in Table 3.0-73 under Alternative 1 the number of activities involving the use of parachutes is four times that of the No Action Alternative. The activities using parachutes under Alternative 1 would occur in the same geographic locations as the No Action Alternative, with the exception of introducing parachutes in the Key West Range Complex. In addition, there are testing activities expending parachutes that could occur throughout the Study Area. Under Alternative 1, there would be a concentration of approximately one parachute per 5 nm^2 if the parachutes were expended evenly throughout the area. Species that occur in these areas, including all ESA-listed species would have the potential to be exposed to parachutes.

Marine fish groups identified in Section 3.9.2 (Affected Environment) and ESA-listed species that could be susceptible to entanglement in parachutes are the same as discussed for cables and wires in Section 3.9.3.4.2.1 (No Action Alternative). For the reasons stated in Section 3.9.3.4.2.1 (No Action Alternative), impacts on Atlantic salmon, smalltooth sawfish, and largetooth sawfish would be discountable.

Sawfish could encounter parachutes expended in the Key West Range Complex that were transported to the nearshore habitats where sawfish occur. However, only one sonobuoy per 7 nm^2 is proposed in this area under Alternative 1, making encounter rates very low. Moreover, sawfish are highly mobile visual predators that could easily avoid a floating or suspended parachute. Under Alternative 1, the risk of entanglement of sawfish resulting from proposed testing activities that expend parachutes would be low.

Fish are unlikely to encounter or become entangled in parachutes because of the large size of the range complexes and testing ranges and the resulting widely scattered expended parachutes. Individual fish are not prone to be repeatedly exposed to parachutes, thus the long-term consequences of entanglement risks from parachutes are unlikely for either individuals or populations.

Pursuant to the ESA, the use of parachutes during testing as described under Alternative 1:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon.*

3.9.3.4.2.3 Alternative 2 (Preferred Alternative)

Training Activities

The number and location of training activities under Alternative 2 are nearly identical to training activities under Alternative 1 (three additional parachutes). Therefore, impacts and comparisons to the No Action Alternative will also be identical as described in Section 3.9.3.4.2.2 (Alternative 1).

Pursuant to the ESA, the use of parachutes during training as described under Alternative 2:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon.*

Testing Activities

Table 3.0-73 lists the number and locations of activities that expend parachutes. The number and footprint of parachutes are detailed in Table 3.3-13. As indicated in Table 3.0-73 under Alternative 2, the number of activities involving the use of parachutes is more than five times that of the No Action Alternative, but only increases by 19 percent as compared to Alternative 1. The activities using parachutes under Alternative 2 would occur in the same geographic locations as the No Action Alternative, with the exception of introducing parachutes in the Key West Range Complex. In addition, there are testing activities expending parachutes that could occur throughout the Study Area. Under Alternative 2, there would be a concentration of approximately one parachute per 4 nm^2 if the parachutes were expended evenly throughout the area. Species that occur in these areas, including all ESA-listed species would have the potential to be exposed to parachutes.

Marine fish groups identified in Section 3.9.2 (Affected Environment) and ESA-listed species that could be susceptible to entanglement in parachutes are the same as discussed for cables and wires in Section 3.9.3.4.2.1 (No Action Alternative). For the reasons stated in Section 3.9.3.4.2.1 (No Action Alternative), impacts on Atlantic salmon, smalltooth sawfish, and largetooth sawfish would be discountable.

Sawfish could encounter parachutes expended in the Key West Range Complex that are transported to the nearshore habitats where sawfish occur. However, only one sonobuoy per 7 nm^2 is proposed in this area under Alternative 2, making encounter rates very low. Moreover, sawfish are highly mobile visual predators that could easily avoid a floating or suspended parachute. Under Alternative 2, the risk of entanglement of sawfish resulting from proposed testing activities that expend parachutes would be low.

Fish are unlikely to encounter or become entangled in parachutes because of the large size of the range complexes and testing ranges and the resulting widely scattered expended parachutes. Individual fish are not prone to be repeatedly exposed to parachutes, thus the long-term consequences of entanglement risks from parachutes are unlikely for either individuals or populations.

Pursuant to the ESA, the use of parachutes during testing activities as described under Alternative 2:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon.*

3.9.3.5 Ingestion Stressors

This section evaluates the potential ingestion impacts of the various types of expended materials used by the Navy during training and testing activities within the Study Area. Aspects of ingestion stressors that are applicable to marine organisms in general are presented in Section 3.0.5.7.5 (Conceptual Framework for Assessing Effects from Ingestion). Ingestion of expended materials by fish could occur in all large marine ecosystems and open ocean areas and can occur at or just below 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 fish. Floating material is more likely to be eaten by fish of all sizes that feed at or near the water surface (e.g., ocean sunfish, basking sharks, whale sharks, manta rays, herring, or flying fish), while materials that sink to the seafloor present a higher risk to bottom-feeding fish (e.g., sturgeon, hammerhead sharks, skates, rays, and flounders).

It is reasonable to assume that any item of a size that can be swallowed by a fish could be eaten at some time; this analysis focuses on ingestion of materials in two locations: (1) at the surface or water column, and (2) at the seafloor. Open-ocean predators and open-ocean planktivores are most likely to ingest materials in the water column. Coastal bottom-dwelling predators and estuarine bottom-dwelling predators could ingest materials from the seafloor. The potential for fish, including the ESA-listed fish species, to encounter and ingest expended materials is evaluated with respect to their feeding group, size, and geographic range, which influence the probability that they would eat military expended materials.

The Navy expends the following types of materials during training and testing in the Study Area that could become ingestion stressors: non-explosive practice munitions (small- and medium-caliber), fragments from high-explosives, fragments from targets, chaff, flare casings (including plastic end caps and pistons), and small parachutes. The activities that expend these items and their general distribution are detailed in Section 3.0.5.3.5 (Ingestion Stressors). Metal items eaten by marine fish are generally small (such as fish hooks, bottle caps, and metal springs), suggesting that small- and medium-caliber projectiles, pistons, or end caps (from chaff canisters or flares) are more likely to be ingested. Both physical and toxicological impacts could occur as a result of consuming metal or plastic materials (Davison and Asch 2011); (Dantas et al. 2012; Possatto et al. 2011). Items of concern are those of ingestible size that either drift at or just below the surface (or in the water column) for a time or sink immediately to the seafloor. The likelihood that expended items would cause a potential impact on a given fish species depends on the size and feeding habits of the fish and the rate at which the fish encounters the item and the composition of the item. In this analysis only small- and medium-caliber munitions (or small fragments from larger munitions), chaff, small parachutes, and end caps and pistons from flares and chaff cartridges are considered to be of ingestible size for a fish. For many small fish species (e.g., herring, anchovy, etc.), even these items (with the exception of chaff) are too large to be ingested. Therefore, the discussion in this section focuses on those fish species large enough to potentially ingest these materials.

The analysis of ingestion impacts on fish is structured around the following feeding strategies:

<u>Feeding at or Just Below the Surface or Within the Water Column</u>

- **Open-Ocean Predators.** Large, migratory, open-ocean fish, such as salmon, tuna, dolphin fish, sharks, and billfish, feed on fast-swimming prey in the water column of the Study Area. These fish range widely in search of unevenly distributed food patches. Atlantic salmon generally travel alone (Fay et al. 2006) but gather in common feeding areas near Greenland and Labrador, where they prey on schooling fish associated with the surface and water column of shallow open-water areas (Hansen and Windsor 2006). Smaller military expended materials could be mistaken for prey items and ingested purposefully or incidentally as the fish is swimming (Table 3.9-6). Prey fish sometimes dive deeper to avoid an approaching predator (Pitcher 1986). A few of these predatory fish (e.g., bull sharks, tiger sharks) are known to ingest any type of marine debris that they can swallow, even automobile tires. Some marine fish, such as the dolphinfish (*Coryphaena hippurus*) (South Atlantic Fishery Management Council 2011) and tuna (Hoss and Settle 1990), eat plastic fragments, strings, nylon lines, ropes, or even small light bulbs.

- **Open-Ocean Planktivores.** Plankton-eating fish in the open-ocean portion of the Study Area include herring, flyingfish, whale sharks, manta rays, and basking sharks. These fish feed by either filtering plankton from the water column or by selectively ingesting larger zooplankton. These planktivores could encounter and incidentally feed on smaller types of military expended materials (e.g., chaff, end caps, and pistons) at or just below the surface or in the water column (Table 3.9-6). None of the species listed under the ESA in the Study Area are open-ocean planktivores, but some species in this group of fish (e.g., herring) constitute a major prey base for many important predators, including salmon, tuna, sharks, marine mammals, and seabirds. While not a plankton eater, the ocean sunfish may also be capable of ingesting items at or just below the surface in the open ocean.

Military expended materials that could potentially impact these types of fish at or just below the surface or in the water column include those items that float or are suspended in the water column for some period of time (e.g., parachutes and end caps and pistons from chaff cartridges or flares).

Table 3.9-6: Summary of Ingestion Stressors on Fish Based on Location

Feeding Guild	Representative Species	Endangered Species Act-Protected Species	Overall Potential for Impact
Open-Ocean Predators	Dolphinfish, Most Shark Species	Atlantic Salmon	These fish may eat floating or sinking expended materials, but the encounter rate would be extremely low. May result in individual injury or death but is not anticipated to have population-level effects.
Open-Ocean Plankton Eaters (Planktivores)	Atlantic Herrings, Menhaden, Basking Shark, Whale Shark	None	These fish may ingest floating expended materials incidentally as they feed in the water column, but the encounter rate would be extremely low. May result in individual injury or death but is not anticipated to have population-level effects.
Coastal Bottom-Dwelling Predators	Atlantic Cod, Skates, Cusk, and Rays	Atlantic Salmon	These fish may eat expended materials on the seafloor, but the encounter rate would be extremely low. May result in individual injury or death but is not anticipated to have population-level effects.
Coastal Bottom-Dwelling Scavengers	Skates and Rays, Flounders	Sturgeon Species, Sawfish Species; Atlantic Salmon (Especially Smolts)	These fish could incidentally eat some expended materials while foraging, especially in muddy waters with limited visibility. However, encounter rate would be extremely low. May result in individual injury or death but is not anticipated to have population-level effects.

Notes: the scientific names of the listed species are as follows: Atlantic cod (*Hippoglossus hippoglossus*), Atlantic salmon (*Salmo salar*), basking shark (*Cetorhinus maximus*), cusk (*Brosme brosme*), dolphinfish (*Coryphaena hippurus*), and whale shark (*Rhincodon typus*).

Fish Feeding at the Seafloor

- **Coastal Bottom-Dwelling Predators.** Large predatory fish near the seafloor are represented by species such as Atlantic cod and cusk, which are typical predators in coastal and deeper nearshore waters of the northern portion of the Study Area (Table 3.9-6). The cod and cusk feed opportunistically on or near the bottom, taking fish and invertebrates from the water column (e.g., shrimp) and from the sediment (e.g., crabs) (Collette and Klein-MacPhee 2002). The cod also ingests marine debris while feeding on or near the bottom. In the United Kingdom, plastic cups thrown from ferries have been discovered in cod stomachs (Hoss and Settle 1990). The varied diet of the cod and the low visibility in its deep shelf habitat may promote the ingestion of foreign objects. The Atlantic salmon also feeds on fish on or near the seafloor such as sand lances and capelin (Mills 1991). The cusk normally eats hard-shelled and spiny organisms, increasing the likelihood that it would swallow a sharp plastic or metal item rather than reject it.
- **Coastal Bottom-Dwelling Scavengers.** Bottom-dwelling fish in the nearshore coasts and estuaries (Table 3.9-6) may feed by seeking prey and by scavenging on dead fish and invertebrates. All sturgeon in the Study Area suction-feed along the bottom in coastal waters on small fish and invertebrate prey, which increases the likelihood of incidental ingestion of marine debris (Ross et al. 2009). The smalltooth and largetooth sawfish primarily inhabit nearshore habitats in southern Florida and other gulf coast locations, such as seagrass beds and mangroves.

Military expended materials that could be ingested by fish at the seafloor include items that sink (e.g., small-caliber projectiles and casings, fragments from high-explosive munitions).

Potential impacts of ingestion on adults are different than for other life stages (larvae and juveniles) because early life stages are too small to ingest any military expended materials except for chaff, which has been shown to have no impact on fish (Arfsten et al. 2002; Spargo 1999; U.S. Air Force 1997). Therefore, no ingestion potential impacts on early life stages would occur, with the exception of later stage juveniles that are large enough to ingest military expended materials.

Within the context of fish location in the water column and feeding strategies, the analysis is divided into (1) munitions (small- and medium-caliber projectiles, and small fragments from larger munitions); and (2) military expended material other than munitions (chaff, chaff end caps, pistons, parachutes, flares, and target fragments).

3.9.3.5.1 Impacts from Munitions or Fragments from High-Explosive Munitions

The potential impacts of ingesting foreign objects on a given fish depend on the species and size of the fish. Fish that normally eat spiny, hard-bodied invertebrates could be expected to have tougher mouths and digestive systems than fish that normally feed on softer prey. Materials that are similar to the normal diet of a fish would be more likely to be ingested and more easily handled once ingested—for example, by fish that feed on invertebrates with sharp appendages. These items could include fragments from high-explosives that a fish could encounter on the seafloor. Relatively small or smooth objects, such as small-caliber projectiles or their casings, might pass through the digestive tract without causing harm. A small sharp-edged item could cause a fish immediate physical distress by tearing or cutting the mouth, throat, or stomach. If the object is rigid and large (relative to the fish's mouth and throat), it may block the throat or obstruct the flow of waste through the digestive system. An object may be enclosed by a cyst in the gut lining (Danner et al. 2009; Hoss and Settle 1990). Ingestion of large foreign objects could lead to disruption of a fish's normal feeding behavior, which could be sublethal or lethal.

Munitions are heavy and would sink immediately to the seafloor, so exposure would be limited to those fish identified as bottom-dwelling predators and scavengers. It is possible that expended small-caliber projectiles on the seafloor could be colonized by seafloor organisms and mistaken for prey or that expended small-caliber projectiles could be accidentally or intentionally eaten during foraging. Over time, the metal may corrode or become covered by sediment in some habitats, reducing the likelihood of a fish encountering the small-caliber, non-explosive practice munitions.

Fish feeding on the seafloor in the offshore locations where these items are expended (e.g., gunnery boxes) would be more likely to encounter and ingest them than fish in other locations. A particularly large item (relative to the fish ingesting it) could become permanently encapsulated by the stomach lining, with the rare chance that this could impede the fish's ability to feed or take in nutrients. However, in most cases, a fish would pass a round, smooth item through its digestive tract and expel it, with no long-term measurable reduction in the individual's fitness.

If high-explosive munitions do not explode, they would sink to the bottom. In the unlikely event that explosive material, high-melting-point explosive (known as HMX) or royal demolition explosive (known as RDX), is exposed on the ocean floor it would break down in a few hours (U.S. Department of the Navy 2001d). HMX or RDX would not accumulate in the tissues of fish (Lotufo et al. 2010; Price et al. 1998). Fish may take up trinitrotoluene (TNT) from the water when it is present at high concentrations but not from sediments (Lotufo et al. 2010). The rapid dispersal and dilution of TNT expected in the marine water column reduces the likelihood of a fish encountering high concentrations of TNT to near zero.

3.9.3.5.1.1 No Action Alternative

Training Activities

Table 3.0-90 lists the number and location of small- and medium-caliber projectiles. As indicated in Table 3.0-90 under the No Action Alternative, the areas with the greatest amount of small- and medium-caliber projectiles would occur in the Northeast and Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems and the Gulf Stream Open Ocean Area—specifically within the VACAPES, Navy Cherry Point, JAX, Key West, and GOMEX Range Complexes. Use of small- and medium-caliber projectiles is concentrated within the VACAPES and JAX Range Complexes. Species that occur in these areas—including all ESA-listed species, except for Atlantic salmon—would have the potential to be exposed to small- and medium-caliber projectiles.

Table 3.0-71 lists the number and location of activities that expend fragments from high-explosive ordnance and munitions (e.g., demolition charges, grenades, bombs, missiles, and rockets). The number and footprint of high-explosive ordnance and munitions are detailed in Table 3.3-9; however, the fragment size cannot be quantified. As indicated Table 3.0-71, under the No Action Alternative, the areas with the greatest amount of high-explosive ordnance and munitions would occur in the Northeast and Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems and the Gulf Stream Open Ocean Area—specifically within the VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes. Use of high-explosive ordnance and munitions is concentrated within the VACAPES Range Complex. Species that occur in these areas—including all ESA-listed species, except for Atlantic salmon—would have the potential to be exposed to fragments from high-explosive ordnance and munitions.

Small-caliber projectiles would be concentrated in the VACAPES Range Complex (one small-caliber projectile per 0.021 nm^2 each year). In contrast, approximately one small-caliber projectile per 0.100 nm^2 would be expended each year in the Navy Cherry Point Range Complex. Encounter rates in locations with concentrated small-caliber projectiles would be assumed greater than encounter rates in less concentrated areas. Atlantic and shortnose sturgeon may occur at the offshore and deeper nearshore locations where small-caliber projectile use is concentrated in the VACAPES Range Complex.

When these items explode, they may break apart or remain largely intact in irregularly shaped pieces—some of which may be small enough for a fish to ingest. Some fish species feed on crustaceans that have hard, sharp, or irregular parts, without any impacts. Most fragments from high-explosives would be too large for a fish to ingest. Also, it is assumed that fragments from larger munitions are similar in size to fragments from smaller munitions. Although fragment size cannot be quantified, more individual fragments would result from larger munitions than from smaller munitions. The number of fragments that would result from the proposed explosions in the No Action Alternative cannot be quantified. However, it is believed to be smaller than the number of small-caliber projectiles to be expended in the Study Area. Small-caliber projectiles would likely be more prevalent throughout the Study Area and more likely to be encountered and potentially ingested by bottom-dwelling fish than fragments from any type of high-explosive munitions.

The Atlantic and Gulf sturgeon may occur in portions of the Study Area out to the continental shelf break where projectiles and munitions are used. Shortnose sturgeon generally remain within their natal river or estuary, only occasionally moving to nearshore marine environments (Dadswell 2006). The current Chesapeake Bay system population of shortnose sturgeon appears to be centered in the upper Chesapeake Bay (Welsh et al. 2002), outside of the Study Area. Training activities expending projectiles or munitions could expose sturgeon to ingestion risk. However, if a sturgeon ingested a small-caliber projectile or fragment, no change to its growth, survival, annual reproductive success, or lifetime reproductive success would be likely to occur. Smalltooth and largetooth sawfish could encounter some ordnance-related material; although the likelihood is remote because there are no small-caliber projectiles expended in the Key West Range Complex portion of the Study Area where sawfish would most likely occur. Most ordnance used during training is expended in deep waters beyond the continental shelf break, where sawfish are not expected to occur.

The potential impacts on smalltooth and largetooth sawfish are discountable because they are historically rare in the locations where munitions are expended. The last confirmed records of the largetooth sawfish in U.S. waters are from Port Aransas, Texas in 1961; Florida in 1941; and Louisiana in 1917 (FR 76 (133): 40822-40836, July 12, 2011). The likelihood of ingestion of munitions (or fragments) by early life stages of sawfish would be slightly less than that of adults because nursery habitats are found in very shallow water (less than 1 m), where no munitions would be expended. Early life stages of sturgeon are typically found in freshwater rivers and not in marine environments, so only juveniles and adults would be potentially exposed to ingestion stressors.

Overall, the potential impacts of ingesting munitions or fragments from munitions would be limited to individual fish that might suffer a negative response from a given ingestion event. While ingestion of munitions or fragments from munitions identified here could result in sublethal or lethal effects to a small number of individuals, the likelihood of a fish encountering an expended item is low based on the dispersed nature of the materials. Furthermore, an encounter may not lead to ingestion, and ingestion may not lead to swallowing. A fish might "taste" an item, then expel it (Felix et al. 1995) in the same manner that a fish would take a lure into its mouth then spit it out. Based on these factors, the number of fish potentially impacted by ingestion of munitions or fragments from munitions would be low, and population-level effects would not be expected.

Pursuant to the ESA, the potential for ingestion of munitions or fragments from munitions during training activities as described under the No Action Alternative:

- *will have no effect on ESA-listed Atlantic salmon; and*
- *may affect but is not likely to adversely affect the ESA-listed smalltooth sawfish, largetooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon.*

Testing Activities

Table 3.0-90 lists the number and location of small- and medium-caliber projectiles. As indicated in Table 3.0-90, under the No Action Alternative, the areas with the greatest amount of small- and medium-caliber projectiles would occur in the Northeast and Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems and the Gulf Stream Open Ocean Area—specifically within the VACAPES, JAX, and GOMEX Range Complexes and the Naval Surface Warfare Center, Panama City Division Testing Range. In addition, less than 10 percent of the total small- and medium-caliber projectiles could be expended anywhere in the Study Area, outside the range complexes while vessels are in transit. Species that occur in these areas—including all ESA-listed species, except for Atlantic salmon—would have the potential to be exposed to small- and medium-caliber projectiles.

Table 3.0-71 lists the number and location of activities that expend fragments from high-explosive ordnance and munitions (e.g., demolition charges, grenades, bombs, missiles, and rockets). The number and footprint of high-explosive ordnance and munitions are detailed in Table 3.3-10; however, the fragment size cannot be quantified. As indicated in Table 3.0-71, under the No Action Alternative, the areas with the greatest amount of high-explosive ordnance and munitions would occur in the Northeast and Southeast U.S. Continental Shelf Large Marine Ecosystems and the Gulf Stream Open Ocean Area—specifically within the VACAPES Range Complex and Naval Surface Warfare Center, Panama City Division Testing Range. Species that occur in these areas—including all ESA-listed species, except for Atlantic salmon—would have the potential to be exposed to fragments from high-explosive ordnance and munitions.

Small-caliber projectiles would be expended in low densities overall, and concentrated in the GOMEX Range Complex (a maximum density of one small-caliber projectile per 3.46 nm^2 each year). In contrast, approximately one small-caliber projectile per 34.48 nm^2 each year would be expended in the VACAPES Range Complex. The rates at which fish encounter small-caliber projectiles is assumed proportional to the number of small-caliber projectiles expended, with a greater encounter rate in the GOMEX Range Complex. Gulf sturgeon and smalltooth sawfish could occur at the deeper portions of nearshore locations where small-caliber projectile use is concentrated in the GOMEX Range Complex. However, neither of these species is common within the GOMEX Range Complex; the likelihood of these species encountering small-caliber munitions is extremely low in this area. Risk of potential impacts of these species ingesting munitions or fragments from munitions resulting from proposed testing activities would be low, as described in Section 3.9.3.5.1.1 (No Action Alternative).

Adult Gulf sturgeon may occur in St. Andrew Bay (Florida) during fall and winter (U.S. Fish and Wildlife Service 2004, 2006). Also, St. Andrew Bay is not part of any of the major freshwater river systems that Gulf sturgeon use during freshwater migration. The largetooth and smalltooth sawfish may also occur in St. Andrew Bay. The potential impacts on smalltooth and largetooth sawfish are discountable because they are historically rare in the locations where munitions are expended. The last confirmed records of the largetooth sawfish in U.S. waters are from Port Aransas, Texas in 1961; Florida in 1941; and Louisiana in 1917 (FR 76 (133): 40822-40836, July 12, 2011). Smalltooth sawfish are rare in the Gulf of Mexico Large Marine Ecosystem, but since 1999 the species has been documented in the vicinity of the Naval Surface Warfare Center, Panama City Division Testing Range; however, only three smalltooth sawfish encounters have been reported and verified since 1998 west of the mouth of St. Andrew Bay (Simpfendorfer and Wiley 2006).

The likelihood of ingestion of munitions (or fragments) by early life stages of sawfish would be slightly less than that of adults, because nursery habitats are found in very shallow water (less than 1 m), where no munitions would be expended. Early life stages of sturgeon are typically found in freshwater rivers and not in marine environments, so only juveniles and adults would be potentially exposed to ingestion stressors.

Overall, the impacts of fish ingesting munitions or fragments from munitions resulting from proposed testing activities would be low. The number of fish potentially impacted by ingestion of munitions or fragments from munitions would be low, and population-level effects would not be expected.

Pursuant to the ESA, the potential for ingestion of munitions or fragments from munitions during testing activities as described under the No Action Alternative:

- *will have no effect on ESA-listed Atlantic salmon; and*
- *may affect but is not likely to adversely affect the ESA-listed smalltooth sawfish, largetooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon.*

3.9.3.5.1.2 Alternative 1

Training Activities

Table 3.0-90 lists the number and location of small- and medium-caliber projectiles. As indicated in Table 3.0-90, under Alternative 1, the amount of small- and medium-caliber projectiles is more than three times that of the No Action Alternative. The activities using small- and medium-caliber projectiles under Alternative 1 would occur in the same geographic locations as the No Action Alternative, with the exception of introducing small- and medium-caliber projectiles in the Northeast Range Complexes and less than 10 percent of the total small- and medium-caliber projectiles could be expended anywhere in the Study Area, outside the range complexes while vessels are in transit. Species that occur in these areas, including all ESA-listed species would have the potential to be exposed to small- and medium-caliber projectiles.

Table 3.0-71 lists the number and location of activities that expend fragments from high-explosive ordnance and munitions (e.g., demolition charges, grenades, bombs, missiles, and rockets). The number and footprint of high-explosive ordnance and munitions are detailed in Table 3.3-11; however, the fragment size cannot be quantified. As indicated in Table 3.0-71, under Alternative 1, the number of activities that use high-explosive ordnance and munitions is more than 13 times that of the No Action Alternative. The activities using high-explosive ordnance and munitions under Alternative 1 would occur in the same geographic locations as the No Action Alternative, with the exception of introducing high-explosive ordnance and munitions in the Northeast Range Complexes, Key West Range Complex, and in the Other AFTT Areas outside of the range complexes while vessels are in transit. Species that occur in these areas, including all ESA-listed species would have the potential to be exposed to fragments from high-explosive ordnance and munitions.

Small-caliber projectiles would be concentrated in the VACAPES Range Complex (one small-caliber projectile per 0.007 nm^2 each year). In contrast, approximately one small-caliber projectile per 0.476 nm^2 would be expended each year in the Navy Cherry Point Range Complex. The rates at which fish encounter small-caliber projectiles is assumed proportional to the number of small-caliber projectiles expended, with a greater encounter rate in the VACAPES Range Complex. Atlantic and shortnose sturgeon may occur at the deeper portions of nearshore locations where small-caliber projectile use is concentrated in the VACAPES Range Complex.

Atlantic salmon and shortnose, Atlantic, and Gulf sturgeon may occur in portions of the Study Area where projectiles and munitions are used. Risk of potential impacts on these species ingesting munitions or fragments from munitions resulting from proposed training activities would be low, as described in Section 3.9.3.5.1.1 (No Action Alternative). The potential impacts on smalltooth and largetooth sawfish are discountable because they are historically rare in the locations where munitions are expended, as described for the No Action Alternative.

The increase of munitions or fragments from munitions under Alternative 1 would not result in an increased ingestion risk for fish because the densities of these items would continue to be low and are not expected to result in long-term impacts, as described in training activities for the No Action Alternative. The number of fish potentially impacted by ingestion of munitions or fragments from munitions would be low, and population-level effects would not be expected.

Pursuant to the ESA, the potential for ingestion of munitions or fragments from munitions during training activities as described under Alternative 1:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, smalltooth sawfish, largetooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon.*

Testing Activities

Table 3.0-90 lists the number and location of small- and medium-caliber projectiles. As indicated in Table 3.0-90, under Alternative 1, the amount of small- and medium-caliber projectiles is approximately 4.3 times that of the No Action Alternative. The activities using small- and medium-caliber projectiles under Alternative 1 would occur in the same geographic locations as the No Action Alternative, with the exception of introducing small- and medium-caliber projectiles in the Key West Range Complex, and testing activities could occur throughout the Study Area. Species that occur in these areas—including all ESA-listed species—would have the potential to be exposed to small- and medium-caliber projectiles.

Table 3.0-71 lists the number and location of activities that expend fragments from high-explosive ordnance and munitions (e.g., demolition charges, grenades, bombs, missiles, and rockets). The number and footprint of high-explosive ordnance and munitions are detailed in Table 3.3-12; however, the fragment size cannot be quantified. As indicated in Table 3.0-71, under Alternative 1, the number of activities that use high-explosive ordnance and munitions is more than 13 times that of the No Action Alternative. The activities using high-explosive ordnance and munitions under Alternative 1 would occur in the same geographic locations as the No Action Alternative, with the exception of introducing high-explosive ordnance and munitions in the Key West and JAX Range Complexes and throughout the Gulf of Mexico. Species that occur in these areas—including all ESA-listed species—would have the potential to be exposed to fragments from high-explosive ordnance and munitions.

Small-caliber projectiles would be concentrated in the VACAPES Range Complex (one small-caliber projectile per 0.752 nm^2 each year). In contrast, approximately one small-caliber projectile per 2.778 nm^2 would be expended each year in the Navy Cherry Point Range Complex. Encounter rates in locations with concentrated small-caliber projectiles would be assumed to be greater than in less concentrated areas. Atlantic and shortnose sturgeon may occur at the deeper portions of nearshore locations where small-caliber projectile use is concentrated in the VACAPES Range Complex.

The shortnose, Atlantic, and Gulf sturgeon may occur in portions of the Study Area where projectiles and munitions are used. Risk of potential impacts on these species from ingesting munitions or fragments from munitions resulting from proposed testing activities would be low as in Section 3.9.3.5.1.1 (No Action Alternative). The potential impacts on smalltooth and largetooth sawfish are discountable because they are historically rare in the locations where munitions are expended, as described for the No Action Alternative.

The increase of munitions or fragments from munitions under Alternative 1 would not result in an increased ingestion risk for fish because the densities of these items in the No Action Alternative would remain low and are not expected to result in long-term impacts. The number of fish potentially impacted by ingestion of munitions or fragments from munitions would be low, and population-level effects would not be expected.

Pursuant to the ESA, the potential for ingestion of munitions or fragments from munitions during testing activities as described under Alternative 1:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, smalltooth sawfish, largetooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon.*

3.9.3.5.1.3 Alternative 2 (Preferred Alternative)

Training Activities

The number and location of training activities under Alternative 2 are identical to training activities under Alternative 1. Therefore, impacts and comparisons to the No Action Alternative will also be identical as described in Section 3.9.3.5.1.2 (Alternative 1).

Pursuant to the ESA, the potential for ingestion of munitions or fragments from munitions during training activities as described under Alternative 2:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, smalltooth sawfish, largetooth sawfish, shortnose sturgeon or Gulf sturgeon.*

Testing Activities

Table 3.0-90 lists the number and location of small- and medium-caliber projectiles. As indicated in Table 3.0-90, under Alternative 2, the amount of small- and medium-caliber projectiles is 4.6 times that of the No Action Alternative, but only increases by 6 percent as compared to Alternative 1. The activities using small- and medium-caliber projectiles under Alternative 2 would occur in the same geographic locations as the No Action Alternative, with the exception of introducing small- and medium-caliber projectiles in the Key West Range Complex, and testing activities could occur throughout the Study Area. Species that occur in these areas—including all ESA-listed species—would have the potential to be exposed to small- and medium-caliber projectiles.

Table 3.0-71 lists the number and location of activities that expend fragments from high-explosive ordnance and munitions (e.g., demolition charges, grenades, bombs, missiles, and rockets). The number and footprint of high-explosive ordnance and munitions are detailed in Table 3.3-13; however, the fragment size cannot be quantified. As indicated in Table 3.0-71, under Alternative 2, the number of activities that use high-explosive ordnance and munitions is more than 14 times that of the No Action Alternative, but only increases by 7 percent as compared to Alternative 1. The activities using high-explosive ordnance and munitions under Alternative 2 would occur in the same geographic locations as the No Action Alternative, with the exception of introducing high-explosive ordnance and munitions in the Key West and JAX Range Complexes as well as throughout the Gulf of Mexico. Species that occur in these areas—including all ESA-listed species—would have the potential to be exposed to fragments from high-explosive ordnance and munitions.

Small-caliber projectiles would be concentrated in the VACAPES Range Complex (one small-caliber projectile per 0.752 nm^2 each year). In contrast, approximately one small-caliber projectile per 2.778 nm^2 would be expended each year in the Navy Cherry Point Range Complex. Encounter rates in locations with concentrated small-caliber projectiles would be assumed to be greater than in less-concentrated areas. Atlantic and shortnose sturgeon may occur at the deeper portions of nearshore locations where small-caliber projectile use is concentrated in the VACAPES Range Complex. The potential impacts on smalltooth and largetooth sawfish are discountable because they are historically rare in the locations where munitions are expended, as described for the No Action Alternative.

The increase of munitions or fragments from munitions under Alternative 2 would not result in an increased ingestion risk for fish because the densities of these items in the Alternative 2 would remain low and are not expected to result in long-term impacts. The number of fish potentially impacted by ingestion of munitions or fragments from munitions would be low, and population-level effects would not be expected.

Pursuant to the ESA, the potential for ingestion of munitions or fragments from munitions during testing activities as described under Alternative 2:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, smalltooth sawfish, largetooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon.*

3.9.3.5.2 Impacts from Military Expended Materials Other than Munitions

Fish feed throughout the water column and could mistake many types of marine debris for prey items. Ingesting nonfood items is common among a variety of marine fish, particularly those that feed on the seafloor (Boerger et al. 2010; Hoss and Settle 1990; Jackson et al. 2000). Many fish are also known to intentionally ingest plastic materials (e.g., plastic fishing lures), although the extent to which a fish might discriminate between a plastic item shaped like a prey item and an indistinct or less appealing shape is not clear. Once eaten, any type of plastic could cause digestive problems for the fish (Danner et al. 2009). Fish have been reported to ingest a variety of materials or debris, such as plastic pellets, bags, rope, and line (Hoss and Settle 1990; Jackson et al. 2000).

Chaff is used throughout the Study Area. As described in Section 3.0.5.3.5.3 (Military Expended Materials Other Than Munitions), fish that ingested high concentrations of chaff under experimental laboratory conditions showed no negative impacts. Based on the small size of chaff fibers, fish would likely not confuse the fibers with prey items or purposefully feed on them. However, fish could occasionally ingest low concentrations of chaff incidentally while feeding on prey items on the surface, in the water column, or the seafloor. Chaff fiber ingestion is not expected to impact fish based on the low concentration that could reasonably be ingested, the small size of the chaff fibers, and the low toxicity of chaff to fish (see Section 3.0.5.3.5.3, Military Expended Materials Other Than Munitions). Therefore, exposure to chaff would cause no injury, mortality, or tissue damage to fish. Potential impacts of chaff ingestion by fish are not discussed further. Impacts of ingestion of the end caps or pistons associated with chaff cartridges are analyzed together with impacts of flares below.

Chaff end caps and pistons sink in saltwater (Spargo 1999). Fish feeding on the seafloor in the deeper portions of nearshore locations where chaff canisters and flares are expended (e.g., range complexes, OPAREAs, and testing ranges) would be more likely to encounter and ingest these items than in other locations. Ingested end caps or pistons could disrupt a fish's feeding behavior or digestive processes. If the item is particularly large relative to the fish ingesting it, the item could become permanently encapsulated by the stomach lining, and potentially lead to starvation and death; however, in most cases, an ingested end cap or piston would pass unhindered through the fish's digestive tract and be expelled. The fish would recover fully, and experience no reduction in reproductive fitness.

As described above, surface-feeding fish have little opportunity to ingest end caps or pistons before they sink. However, some of these items could become entangled in dense *Sargassum* mats near the surface. Predatory open-ocean fish, such as tuna, dolphinfish, and billfish, are attracted to the many small prey species associated with *Sargassum* mats. While foraging near the floating mats, predatory fish may incidentally ingest end caps and pistons. The density of these items in any given location would vary based on release points and dispersion by wind and water currents. The number of end-caps and pistons that would remain at or just below the surface in *Sargassum* mats and potentially available to fish is unknown. Unlike other plastic types of marine debris, end caps and pistons are heavier than water and not expected to float unless they are enmeshed in *Sargassum* or other floating debris.

Most materials associated with airborne mine neutralization system activities are recovered, but pieces of fiber optic cable may be expended (U.S. Department of the Navy 2001a). For a discussion of the physical characteristics of these expended materials, where they are used, and the number of activities in each alternative, please see Section 3.0.5.3.4.1 (Fiber Optic Cables and Guidance Wires).

Only small amounts of fiber optic cable would be deposited onto the seafloor each year and the small amount of fiber optic cable expended during training and testing would sink to the seafloor. Highly migratory pelagic predators such as dolphinfish and tuna would be unlikely to encounter the small, dispersed lengths of fiber optic cable unless they were in the immediate area when the cable was expended. The low number of fiber optic cables expended in the Study Area during this activity makes it unlikely that fish would encounter any fiber optic cables. Potential impacts of fiber optic cable ingestion by fish are not discussed further.

3.9.3.5.2.1 No Action Alternative

Training Activities

Tables 3.0-73, 3.0-91, and 3.0-93 list the number and locations of activities that expend parachutes, target materials, chaff, and flares. The number and footprint of target materials are detailed in Table 3.3-9.

As indicated in Table 3.0-73, under the No Action Alternative, activities involving parachute use would occur in the Northeast and Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems as well as the Gulf Stream and North Atlantic Gyre Open Ocean Areas—specifically within the Northeast, VACAPES, Navy Cherry Point, JAX, Key West, and GOMEX Range Complexes. Under the No Action Alternative, small parachutes associated with sonobuoys could be potentially ingested by open-ocean plankton eaters (e.g., whale sharks, basking sharks, and ocean sunfish). The only fish species large enough to eat a parachute that feeds on items that size is the ocean sunfish, which could mistake a small parachute for a jellyfish and ingest it. Only 4 percent of the sonobuoys expended in the Study Area would be expended in open ocean areas (Other AFTT Areas—outside of range complexes) where ocean sunfish primarily occur. This results in a density of approximately one sonobuoy per 1,675 nm^2 in these locations. With this low density of parachutes, it is not likely that an ocean sunfish would encounter any sonobuoy parachutes; therefore, the risk of ingestion is extremely low for these fish. Fish that do not occur in the areas where these types of military expended materials are used, would not be exposed to this stressor. For the ESA-listed Atlantic salmon, they would only be exposed to parachutes expended in the Northeast Range Complexes, but these items are too large for them to ingest. Therefore, potential impacts on Atlantic salmon at the individual or population level would not be expected.

As indicated in Section 3.0.5.3.5.3 (Military Expended Materials Other Than Munitions) under the No Action Alternative, activities involving target materials use would occur in the Northeast and Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems as well as the Gulf Stream and North Atlantic Gyre Open Ocean Areas—specifically within the Northeast, VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes. All of the ESA-listed species occur where target materials could potentially be expended. The potential impacts of these fragments are identical to those of fragments from high-explosive munitions, as described in Section 3.9.3.5.1.1 (No Action Alternative).

As indicated in Sections 3.0.5.3.5.3 (Military Expended Materials Other Than Munitions), under the No Action Alternative, activities involving chaff and flare use would occur in the Northeast and Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems as well as the Gulf Stream Open Ocean Areas—specifically within the VACAPES, Navy Cherry Point, JAX, Key West, and GOMEX Range Complexes. No potential impacts would occur from the chaff itself, as previously discussed, but there is some potential for fish to ingest the end caps or pistons associated with the chaff cartridges. Under the No Action Alternative, the smalltooth and largetooth sawfish and sturgeon may occur at the locations where chaff and flares are concentrated in the VACAPES, Key West, and GOMEX Range Complexes. Species occurring outside the specified areas within these range complexes, such as the ESA-listed Atlantic salmon would not be exposed to chaff or flares.

The highest density of chaff and flare end caps and pistons would be expended in the Key West Range Complex. Assuming that all end caps and pistons would be evenly dispersed in the Key West Range Complex, the relative end cap and piston concentration would be very low (2.8 pieces/nm^2/year, based on an area of 25,500 nm^2 and 71,885 end-caps and pistons per year). Environmental concentrations would vary based on release points and dispersion by wind and water currents. The number of end caps and pistons that would remain at or just below the surface in *Sargassum* mats and potentially available to fish is unknown but is expected to be an extremely small percentage of the total. The smalltooth and largetooth sawfish may occur at the locations where chaff and flare use is concentrated in the Key West Range Complex.

The ESA-listed species in the Key West Range Complex are bottom feeders, and would not encounter end caps or flares at the surface. The smalltooth sawfish could ingest an item after it settled to the bottom, but the item would most likely pass through the digestive tract of larger fish without causing harm (see Section 3.9.3.5.1.1, No Action Alternative). Based on the low density of expended endcaps and pistons, the encounter rate would be extremely low, and the ingestion rate even lower. No chaff or flares are planned for use in the Northeast Range Complexes where the Atlantic salmon occurs. The number of fish potentially impacted by ingestion of end caps or pistons would be low based on the low environmental concentration. Population-level effects would not be expected.

Overall, the potential impacts of ingesting parachutes, target fragments, or end caps and pistons would be limited to individual fish that ingest an item too large to pass through its gut. Fish encounter many items (natural and manmade) in their environment that are unsuitable for ingestion and most species have behavioral mechanisms for spitting out the item. If the item were swallowed, it could either pass through the digestive system without doing any harm, or become lodged inside the fish and cause injury or mortality.

For sawfish, the likelihood of ingestion of military expended materials other than munitions by early life stages would be slightly less than that of adults, because nursery habitats are found in very shallow water (less than 1 m), where no military expended materials would occur. The potential impacts on smalltooth and largetooth sawfish are discountable because they are historically rare in the locations where military expended materials are expended. Early life stages of sturgeon are typically found in freshwater rivers and not in marine environments, so only juveniles and adults would be potentially exposed to ingestion stressors.

Although ingestion of military expended materials identified here could result in sublethal or lethal effects, the likelihood of ingestion is low based on the dispersed nature of the materials, the limited encounter rate of fish to the expended items, behavioral mechanisms for expelling the item, and the capacity of the fish's digestive system to simply pass the item through as waste. Based on these factors, the number of fish potentially impacted by ingestion of military expended materials (such as chaff and flare end caps and pistons) would be low, and no population-level effects would be expected.

Pursuant to the ESA, the potential for ingestion of military expended materials other than munitions during training activities as described under the No Action Alternative:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, smalltooth sawfish, largetooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon.*

Testing Activities

Tables 3.0-73, 3.0-91, and 3.0-93 list the number and locations of activities that expend parachutes, target materials, chaff, and flares. The number and footprint of target materials are detailed in Table 3.3-10.

As indicated in Table 3.0-73, under the No Action Alternative, activities involving parachute use would occur in the Northeast and Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems as well as the Gulf Stream and North Atlantic Gyre Open Ocean Areas—specifically within the Northeast, VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes and in the sinking exercise box outside the range complexes. In addition, there are testing activities that could expend parachutes outside of the range complexes in Other AFTT Areas. As described in Section 3.9.3.5.2.1 (No Action Alternative), small parachutes associated with sonobuoys could be ingested by large ocean sunfish mistaking them for jellyfish. Only 4 percent of the sonobuoys used in the Study Area would be expended in open ocean areas (Other AFTT Areas—outside of range complexes), which results in about one sonobuoy per 12,192 nm^2 in these locations. An ocean sunfish would be extremely unlikely to encounter a parachute or to ingest one that was encountered; therefore, the risk of ingestion is extremely low for these fish. Fish that do not occur in the areas where these types of military expended materials are used, would not be exposed to this stressor. For the ESA-listed Atlantic salmon, they would only be exposed to parachutes expended in the Northeast Range Complexes, but these items are too large for them to ingest. Therefore potential impacts on Atlantic salmon at the individual or population level would not be expected.

As indicated in Section 3.0.5.3.5.3 (Military Expended Materials Other Than Munitions) under the No Action Alternative, activities involving target materials use would occur in the Northeast and Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems as well as the Gulf Stream and North Atlantic Gyre Open Ocean Areas—specifically within the Northeast, VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes. In addition, activities that expend target materials would occur at Naval Undersea Warfare Center Division, Newport Testing Range. All of the ESA-listed species occur where target materials could potentially be expended. The potential impacts of these fragments are identical to those of fragments from high-explosive munitions, as described in Section 3.9.3.5.1.1 (No Action Alternative).

As indicated in Sections 3.0.5.3.5.3 (Military Expended Materials Other Than Munitions), under the No Action Alternative, activities involving chaff and flare use would occur in the Northeast and Southeast U.S. Continental Shelf, and Gulf of Mexico Large Marine Ecosystems as well as the Gulf Stream Open Ocean Areas—specifically within the VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes. No potential impacts would occur from the chaff itself, as previously discussed, but there is some potential for the end caps or pistons associated with the chaff cartridges to be ingested. The ESA-listed sawfish and sturgeon may occur at the locations where the greatest chaff and flares are expended in the VACAPES Range and Key West Range Complexes. Species occurring outside the specified areas within these range complexes, such as the ESA-listed Atlantic salmon would not be exposed to chaff and flare end caps.

The ESA-listed species in the VACAPES Range Complex are bottom feeders, and would not encounter parachutes, end caps, target materials, or flares at the surface while feeding. The smalltooth sawfish or sturgeon could ingest one of these items after it settled to the bottom, but the item would most likely pass through the digestive tract of a larger fish without causing harm, as the items measure only 1.3 in. (3.3 cm) in diameter and 0.13 in. (0.3 cm) in thickness. Based on the low density of expended end caps and pistons, the encounter rate would be extremely low, and the ingestion rate even lower. No chaff or flares are planned for use in the Northeast Range Complexes where the Atlantic salmon occurs. The number of fish potentially impacted by ingestion of end caps or pistons would be low based on the low environmental concentration. Population-level effects would not be expected.

The potential impacts on smalltooth and largetooth sawfish are discountable because they are historically rare in the locations where parachutes, chaff, targets, and end-caps are expended. The last confirmed records of the largetooth sawfish in U.S. waters are from Port Aransas, Texas in 1961; Florida in 1941; and Louisiana in 1917 (FR 76 (133): 40822-40836, July 12, 2011). Smalltooth sawfish are rare in the Gulf of Mexico Large Marine Ecosystem, but since 1999 the species has been documented in the vicinity of the Naval Surface Warfare Center, Panama City Division Testing Range; however, only three smalltooth sawfish encounters have been reported and verified since 1998 west of the mouth of St. Andrew Bay (Simpfendorfer and Wiley 2006).

For sawfish, the early life stages have the same body-type as adults; however, the likelihood of ingestion of military expended materials other than munitions by early life stages would be slightly less than that of adults, because nursery habitats are found in very shallow water (less than 1 m [3 ft.]), where no military expended materials would be expended. Early life stages of sturgeon are typically found in freshwater rivers and not in marine environments, so only juveniles and adults would be potentially exposed to ingestion stressors.

Overall, the risk of potential impacts of fish ingesting military expended materials resulting from proposed testing activities would be low.

Pursuant to the ESA, the potential for ingestion of military expended materials other than munitions during testing activities as described under the No Action Alternative:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon.*

3.9.3.5.2.2 Alternative 1

Training Activities

Tables 3.0-73, 3.0-91, and 3.0-93 list the number and locations of activities that expend parachutes, target materials, chaff, and flares. The number and footprint of target materials are detailed in Table 3.3-11.

As indicated in Table 3.0-73, under Alternative 1 the number of activities involving the use of parachutes are 5 percent higher than that of the No Action Alternative. In addition to the geographic locations identified in the No Action Alternative, parachutes would also be expended in the Key West Range Complex, as well as anywhere in the Study Area, outside the range complexes while vessels are in transit. For reasons described in the No Action Alternative, ocean sunfish could mistake small parachutes for jellyfish while foraging in open ocean areas. However, the density of expended sonobuoys in the open ocean areas would amount to approximately one sonobuoy per 1,562 nm^2, making it extremely unlikely that an ocean sunfish would encounter any parachutes; therefore, the risk of ingestion is extremely low for these fish. Species occurring outside the specified areas within these range complexes, such as the ESA-listed Atlantic salmon would not be exposed to parachutes.

As indicated in Section 3.0.5.3.5.3 (Military Expended Materials Other Than Munitions) under Alternative 1, the number of activities that expend target-related materials is about four times that of the No Action Alternative. In addition to the geographic locations identified in the No Action Alternative, target-related materials would also be expended in the Key West Range Complex, as well as anywhere in the Study Area outside the range complexes while vessels are in transit. All of the ESA-listed species occur where target materials could potentially be expended. The potential impacts of these fragments are identical to those of fragments from high-explosive munitions, as described in Section 3.9.3.5.1.1 (No Action Alternative).

As indicated in Sections 3.0.5.3.5.3 (Military Expended Materials Other Than Munitions), under Alternative 1, the number of activities that expend chaff decreases by 30 percent from the No Action Alternative, while flares increase by 30 percent. The activities using chaff and flares under Alternative 1 would occur in the same geographic locations as the No Action Alternative. The ESA-listed species in the VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes are bottom feeders, and would not encounter end caps or pistons at the surface, as described for the No Action Alternative above. No chaff or flares are planned for use in the Northeast Range Complexes where the Atlantic salmon occurs. The number of fish potentially impacted by ingestion of end caps or pistons would be low based on the low environmental concentration. Population-level effects would not be expected. The differences in species overlap and potential impacts from ingestion of military expended material on marine fish groups and ESA-listed species during training activities would not be discernible from those described for training activities in Section 3.9.3.5.2.1 (No Action Alternative).

Pursuant to the ESA, the potential for ingestion of military expended materials other than munitions during training activities as described under Alternative 1:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon.*

Testing Activities

Tables 3.0-73, 3.0-91, and 3.0-93 list the number and locations of activities that expend parachutes, target materials, chaff, and flares. The number and footprint of target materials are detailed in Table 3.3-12.

As indicated in Table 3.0-73, under Alternative 1 the number of activities involving the use of parachutes is approximately four times that of the No Action Alternative. The activities using parachutes under Alternative 1 would occur in the same geographic locations as the No Action Alternative, with the exception of introducing parachutes in the Key West and Gulf of Mexico Range Complexes. In addition, there are testing activities that could expend parachutes throughout the Study Area. For reasons described in the No Action Alternative, ocean sunfish could mistake parachutes for jellyfish while foraging in open ocean areas. Those locations would have about one sonobuoy per 12,192 nm^2. With this sparse distribution of parachutes, it is not likely that an ocean sunfish would encounter any sonobuoy parachutes; therefore, the risk of ingestion is extremely low for these fish. Species occurring outside the specified areas within these range complexes, such as the ESA-listed Atlantic salmon would not be exposed to parachutes.

As indicated in Section 3.0.5.3.5.3 (Military Expended Materials Other Than Munitions), under Alternative 1, the number of activities that expend target-related materials of ingestible size is approximately two times that of the No Action Alternative. In addition to the geographic locations identified in the No Action Alternative, target-related materials would also be expended in the Key West and GOMEX Range Complexes. In addition, there are testing activities that could expend target-related materials throughout the Study Area. All of the ESA-listed species occur where target materials could potentially be expended. The potential impacts of these fragments are identical to those of fragments from high-explosive munitions, as described in Section 3.9.3.5.1.1 (No Action Alternative).

As indicated in 3.0.5.3.5.3 (Military Expended Materials Other Than Munitions), under Alternative 1, the number of activities that expend chaff and flares is approximately four times and three times, respectively, compared to the No Action Alternative. The activities using chaff and flares under Alternative 1 would occur in the same geographic locations as the No Action Alternative. ESA-listed sawfish and sturgeon at these locations are bottom feeders that are not expected to encounter expended items in any great numbers. No chaff or flare use is planned in the Northeast Range Complexes where the Atlantic salmon occurs. Only a small number of individuals could be impacted by ingestion of end caps based on the low environmental concentration of these items; no population-level effects would be expected. Atlantic and shortnose sturgeon may occur at the locations where chaff use is concentrated, such as in the VACAPES Range Complex. The potential impacts on smalltooth and largetooth sawfish are discountable because they are historically rare in the locations where parachutes, chaff, targets, and end-caps are expended, as described for the No Action Alternative. The differences in species overlap and potential impacts from ingestion of military expended material on marine fish groups and ESA-listed species during training activities would not be discernible from those described for testing activities in Section 3.9.3.5.2.1 (No Action Alternative).

Pursuant to the ESA, the potential for ingestion of military expended materials other than munitions during testing activities as described under Alternative 1:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon.*

3.9.3.5.2.3 Alternative 2 (Preferred Alternative)

Training Activities

The number and location of training activities under Alternative 2 are identical to training activities under Alternative 1. Therefore, impacts and comparisons to the No Action Alternative would also be identical as described in Section 3.9.3.5.2.2 (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:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon.*

Testing Activities

Tables 3.0-73, 3.0-91, and 3.0-93 list the number and locations of activities that expend parachutes, target materials, chaff, and flares. The number and footprint of target materials are detailed in Table 3.3-13.

As indicated in Table 3.0-73, under Alternative 2 the number of activities involving the use of parachutes is more than five times that of the No Action Alternative, but increases by approximately 20 percent as compared to Alternative 1. The activities using parachutes under Alternative 2 would occur in the same geographic locations as the No Action Alternative, with the exception of introducing parachutes in the Key West Range Complex. In addition, there are testing activities that could expend parachutes throughout the Study Area. For reasons described in the No Action Alternative, ocean sunfish could mistake parachutes for jellyfish while foraging in open ocean areas where one sonobuoy would be expended for every 11,098 nm^2. With this extremely low concentration, it is not likely that an ocean sunfish would encounter any sonobuoy parachutes; therefore, the risk of ingestion is extremely low for these fish. Species occurring outside the specified areas within these range complexes, such as the ESA-listed Atlantic salmon would not be exposed to parachutes.

As indicated in Section 3.0.5.3.5.3 (Military Expended Materials Other Than Munitions), under Alternative 2, the number of activities that expend target-related materials is more than 2.5 times that of the No Action Alternative, but only increases by approximately 10 percent from Alternative 1. In addition to the geographic locations identified in the No Action Alternative, target-related materials would also be expended in the Key West and GOMEX Range Complexes. In addition, there are testing activities that could expend target-related materials throughout the Study Area. All of the ESA-listed species occur where target materials could potentially be expended. The potential impacts of these fragments are identical to those of fragments from high-explosive munitions, as described in Section 3.9.3.5.1.1 (No Action Alternative).

As indicated in 3.0.5.3.5.3 (Military Expended Materials Other Than Munitions), under Alternative 2, the number of activities that expend chaff is nearly four times that of the No Action Alternative, but only increases by approximately 10 percent from Alternative 1. Under Alternative 2, the number of activities that expend flares is nearly three times that of the No Action Alternative, but only increases by approximately 10 percent from Alternative 1. The activities using chaff and flares under Alternative 2 would occur in the same geographic locations as the No Action Alternative.

The ESA-listed sturgeons and sawfish in these locations are closely associated with the bottom. The potential impacts on smalltooth and largetooth sawfish are discountable because they are historically rare in the locations where parachutes, chaff, targets, and end-caps are expended, as described for the No Action Alternative. No chaff or flare use is planned in the Northeast Range Complexes where the Atlantic salmon occurs. Few individual fish would encounter or ingest end caps; no population-level effects would be expected. The increase of military expended materials under Alternative 2 would not result in an increased ingestion risk for fish because the densities of these items in the Alternative 2 would remain low.

Pursuant to the ESA, the potential for ingestion of military expended materials other than munitions during testing activities as described under Alternative 2:

- *may affect but is not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon.*

3.9.3.6 Secondary Stressors

This section analyzes potential effects on fish exposed to stressors indirectly through impacts on their habitat (i.e., sediment or water quality, and physical disturbance). These are also primary elements of marine fish habitat, and firm distinctions between indirect effects and habitat effects are difficult to maintain. For this analysis, indirect effects on fish via sediment or water that do not require trophic transfer (e.g., bioaccumulation) to be observed are considered. It is important to note that the term "indirect" does not imply reduced severity of environmental consequences but instead describes *how* the effect may occur in an organism or its ecosystem.

Stressors from Navy training and testing activities could pose indirect impacts on fish via changes in habitat, sediment, and water quality. These include (1) explosives; (2) explosion byproducts and unexploded ordnance; (3) metals; (4) chemicals; (5) other materials such as targets, chaff, and plastics; and (6) physical disturbance. Activities associated with these stressors are detailed in Tables 2.8-1 to 2.8-3 and Table 3.0-8, and their potential effects are analyzed in Section 3.1 (Sediments and Water Quality) and Section 3.3 (Marine Habitats).

3.9.3.6.1 Explosives

In addition to directly impacting fish and fish habitat, underwater explosions could impact other species in the food web, including plankton and other prey species that fish feed upon. The effects of underwater explosions would differ depending upon the type of prey species in the area of the blast. As discussed in Section 3.9.3.1 (Acoustic Stressors), fish with swim bladders are more susceptible to blast injuries than fish without swim bladders.

In addition to physical effects of an underwater blast, 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. The sound from underwater explosions might induce startle reactions and temporary dispersal of schooling fish if they are nearby (Kastelein et al. 2008). The abundances of fish and invertebrate prey species near the detonation point could be diminished for a short period 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 and in turn could be susceptible to directly injury or death by subsequent explosions. Any of these scenarios would be temporary, occurring only during activities involving explosives; no lasting effect on prey availability or the pelagic food web would be expected. Indirect effects of underwater detonations and high-explosive ordnance use under the Proposed Action would not decrease the quantity or quality of fish populations or fish habitats in the Study Area.

3.9.3.6.2 Explosion Byproducts and Unexploded Ordnance

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 (Table 3.1-10). Undetonated explosives associated with ordnance disposal and mine clearance are collected after training is complete; therefore, potential impacts are assumed to be inconsequential for these training and testing activities, but other activities could leave these items on the seafloor. Fish may be exposed by contact with the explosive, contact with contaminants in the sediment or water, and ingestion of contaminated sediments.

High-order explosions consume most of the explosive material, creating typical combustion products. In the case of royal demolition explosive, 98 percent of the products are common seawater constituents, and the remainder is rapidly diluted below threshold effect level (see Section 3.1.3.1.2 [Background] and Table 3.1-13 and 3.1-14). Explosion byproducts associated with high-order detonations present no secondary stressors to fish through sediment or water. However, low-order detonations and unexploded ordnance present elevated likelihood of effects on fish.

Indirect effects on fish of explosives and unexploded ordnance via sediment are possible in the immediate vicinity of the ordnance. Degradation of explosives proceeds via several pathways discussed Section 3.1.3.1 (Explosives and Explosion Byproducts). Degradation products of royal demolition explosive are not toxic to marine organisms at realistic exposure levels (Rosen and Lotufo 2010). TNT and its degradation products impact developmental processes in fish and are acutely toxic to adults at concentrations similar to real-world exposures (Halpern et al. 2008a; Rosen and Lotufo 2010). The 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 6 to 12 in. (0.15 to 0.3 m) away from degrading ordnance, the concentrations of these compounds were not statistically distinguishable from background beyond 3 to 6 ft. (1 to 2 m) from the degrading ordnance (Section 3.1.3.1, Explosives and Explosion Byproducts). Taken together, it is likely that various life stages of fish could be impacted by the indirect effects of degrading explosives within a radius of 1 to 6 ft. (0.3 to 2 m) around the explosive.

3.9.3.6.3 Metals

Certain metals and metal-containing compounds are harmful to fish at concentrations above background levels (e.g., cadmium, chromium, lead, mercury, zinc, copper, manganese, and many others) (Wang and Rainbow 2008). Metals are introduced into seawater and sediments as a result of training and testing activities involving vessel hulks, targets, ordnance, munitions, batteries, and other military expended materials (extensively discussed in Section 3.1.3.2, Metals). Some metals bioaccumulate, and physiological impacts begin to occur only after several trophic transfers concentrate the toxic metals (U.S. Department of the Navy 2012). Indirect effects of metals on fish via sediment and water involve concentrations several orders of magnitude lower than concentrations achieved via bioaccumulation. Fish may be exposed by contact with the metal, contact with contaminants in the sediment or water, and ingestion of contaminated sediments. Concentrations of metals in seawater are orders of magnitude lower than concentrations in marine sediments. It is extremely unlikely that fish would be indirectly impacted by toxic metals via the water.

3.9.3.6.4 Chemicals

Several Navy training and testing activities introduce potentially harmful chemicals into the marine environment, principally flares and propellants for rockets, missiles, and torpedoes. Polychlorinated biphenyls (PCBs) are discussed in Section 3.1.3.3 (Chemicals Other Than Explosives), but there is no additional risk to fish because the Proposed Action does not introduce this chemical into the Study Area and the use of polychlorinated biphenyls has been nearly zero since 1979. Properly functioning flares missiles, rockets, and torpedoes combust most of their propellants, leaving benign or readily diluted soluble combustion byproducts (e.g., hydrogen cyanide). Operational failures allow propellants and their degradation products to be released into the marine environment. The greatest risk to fish from flares, missile, and rocket propellants is perchlorate. Fish may be exposed by contact with contaminated water or ingestion of contaminated sediments. However, perchlorate, is highly soluble in water and does not readily adsorb to sediments. Therefore, missile and rocket fuel poses no risk of indirect impact on fish via sediment. In contrast, the principal toxic components of torpedo fuel, propylene glycol dinitrate, and nitrodiphenylamine, adsorb to sediments, have relatively low toxicity, and are readily degraded by biological processes (Section 3.1.3.3, Chemicals Other Than Explosives). It is conceivable that various life stages of fish could be indirectly impacted by propellants via sediment within a few inches of the object, but these potential effects would diminish rapidly as the propellant degrades.

3.9.3.6.5 Other Materials

Some military expended materials (e.g., parachutes) could become remobilized after their initial contact with the seafloor (e.g., by waves or currents) and could be reintroduced as an entanglement or ingestion hazard for fish. In some bottom types (without strong currents, hard-packed sediments, and low biological productivity), items such as projectiles might remain intact for some time before becoming degraded or broken down by natural processes. Such items were observed in the JAX CC range bottom mapping and habitat characterization survey (U.S. Department of the Navy 2011). While these items remain intact sitting on the bottom, they could potentially remain ingestion hazards. These potential impacts may cease only (1) when the military expended materials is too massive to be mobilized by typical oceanographic processes, (2) if the military expended materials becomes encrusted by natural processes and incorporated into the seafloor, or (3) when the military expended materials becomes permanently buried. In this scenario, a parachute could initially sink to the seafloor but then be transported laterally through the water column or along the seafloor, increasing the opportunity for entanglement. In the unlikely event that a fish would become entangled, injury or mortality could result.

The entanglement stressor will eventually cease to pose an entanglement risk as it becomes encrusted or buried.

3.9.3.6.6 Physical Disturbance

The Proposed Action could result in localized and temporary changes to the benthic community during activities that impact fish habitat. Fish habitat could become degraded during activities that would strike the seafloor or introduce military expended materials, bombs, projectiles, missiles, rockets or fragments to the seafloor. During or following activities that impact benthic habitats, fish species may experience loss of available benthic prey at locations in the Study Area where these items might be expended on Essential Fish Habitat or Habitat Areas of Particular Concern. Additionally, plankton and zooplankton that fish eat may also be negatively impacted by these expended materials. The spatial area of Essential Fish Habitat and Habitat Areas of Particular Concern impacted by the Proposed Action would be relatively small compared to the available habitat in the Study Area. However, there would still be vast expanses of Essential Fish Habitat and Habitat Areas of Particular Concern adjacent to the areas of habitat impact that would remain undisturbed by the Proposed Action.

Impacts of vessel disturbance and strike during amphibious assaults could temporarily reduce the quality and quantity of benthic substrate (sand) Essential Fish Habitat over an extremely localized and limited area within Onslow Beach and Seminole Beach. Fish in the taxonomic group that includes the snapper-grouper complex (as managed by the South Atlantic Fishery Management Council), use these designated amphibious assault areas with sandy benthic substrate as Essential Fish Habitat and could be impacted by this activity. However, the secondary habitat impacts on these fish would be extremely localized compared to the total available area of sandy substrate available in the JAX and VACAPES Range Complexes and the overall Study Area.

Impacts of physical disturbance and strikes by small-, medium-, and large-caliber projectiles would be concentrated within designated gunnery box areas, resulting in localized disturbances of hard bottom areas, but could occur anywhere in the range complexes or the Study Area. Hard bottom is important habitat for many different species of fish, including those fish in the snapper-grouper complex (as managed by the South Atlantic Fishery Management Council). It is estimated that hard bottom or biogenic Essential Fish Habitat covers 45 percent of the area of Charleston and JAX OPAREAs combined, 30 percent of the Cherry Point OPAREA, 12 percent of the VACAPES Range Complex area, and 7 percent of the Key West Range Complex area (Florida Fish and Wildlife Conservation Commission 2005). The likelihood these habitats would be impacted is greater in the Charleston, JAX, and Cherry Point OPAREAs compared to the VACAPES and Key West Range Complexes, based solely on these percentages. However, the location with the smallest proportion of hard bottom habitat (the VACAPES Range Complex) has the greatest concentration of small-caliber projectiles expended in the Study Area, with nearly 63 percent of the total 6,150,505 small-caliber projectiles expended. Because the VACAPES Range Complex includes only 12 percent hard bottom, the indirect impacts on the fish using hard bottom habitat in the Study Area would be minimal.

When a projectile hits a biogenic habitat, the substrate immediately below the projectile is not available as that habitat type until the material corrodes (over the long term). The substrate surrounding the projectile would be disturbed, possibly resulting in short-term, localized, and increased turbidity. Because of the large spatial area of the range complexes compared to the small percentage covered by biogenic habitat, it is unlikely that most of the small-, medium-, and large-caliber projectiles expended in the Study Area would fall onto this habitat type. Furthermore, these activities are distributed within discrete locations within the Study Area, and the overall footprint of these areas is quite small with respect to the spatial extent of this biogenic habitat within the Study Area.

Sinking exercises could also result in indirect impacts on deep-sea populations. These activities occur in open ocean areas, outside of the coastal range complexes, shown in Figure 3.0-2 and 3.0-3, with potential direct disturbance or strike impacts on deep-sea fish, covered in Section 3.9.3.5.1 (Impacts from Munitions or Fragments from High-Explosive Munitions). Indirect impacts on these fish could occur after the ship hulks sink to the seafloor. Over time, the ship hulk would be colonized by marine organisms that attach to hard surfaces. For fish that feed on these types of organisms, or whose abundances are limited by available hard structural habitat, the ships that are sunk during sinking exercises could provide an incidental beneficial impact on the deep-sea fish community (Love and York 2005; Macreadie et al. 2011).

3.9.3.6.7 No Action Alternative, Alternative 1, and Alternative 2 (Preferred Alternative) – Training

Pursuant to the ESA, secondary stressors resulting from training activities as described under the No Action Alternative, Alternative 1, and Alternative 2:

- *may affect but are not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon; and*
- *will have no effect on Atlantic salmon, smalltooth sawfish, or Gulf sturgeon critical habitat.*

3.9.3.6.8 No Action Alternative, Alternative 1, and Alternative 2 (Preferred Alternative) – Testing

Pursuant to the ESA, secondary stressors resulting from testing activities as described under the No Action Alternative, Alternative 1, and Alternative 2:

- *may affect but are not likely to adversely affect the ESA-listed Atlantic salmon, largetooth sawfish, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, or Gulf sturgeon; and*
- *will have no effect on Atlantic salmon, smalltooth sawfish, or Gulf sturgeon critical habitat.*

3.9.4 Summary of Potential Impacts on Fish

3.9.4.1 Combined Impacts of All Stressors

As described in Section 3.0.5.5 (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 individual stressor are discussed in the analyses of each stressor in the sections above and summarized in Sections 3.9.4.2 (Endangered Species Act Determinations).

There are generally two ways that a fish could be exposed to multiple stressors. The first would be if a fish were exposed to multiple sources of stress from a single activity (e.g., a mine warfare activity may include the use of a sound source and a vessel). The potential for a combination of these impacts from a single activity would depend on the range of effects of each stressor and the response or lack of response to that stressor. Most of the activities as described in the Proposed Action involve multiple stressors; therefore, it is likely that if a fish were within the potential impact range of those activities, they may be impacted by multiple stressors simultaneously. This would be even more likely to occur during large-scale exercises or activities that span a period of days or weeks (such as a sinking exercises or composite training unit exercise).

Secondly, a fish could be exposed to a combination of stressors from multiple activities over the course of its life. This is most likely to occur in areas where training and testing activities are more concentrated (e.g., near naval ports, testing ranges, and routine activity locations outlined in Table 3.0-2) and in areas that individual fish frequent because it is within the animal's home range, migratory corridor, spawning or feeding area. Except for in the few concentration areas mentioned above, combinations are unlikely to occur because training and testing activities are generally separated in space and time in such a way that it would be very unlikely that any individual fish would be exposed to stressors from multiple activities. However, animals with a home range intersecting an area of concentrated Navy activity have elevated exposure risks relative to animals that simply transit the area through a migratory corridor. The majority of the proposed training and testing activities occur over a small spatial scale relative to the entire Study Area, have few participants, and are of a short duration (on the order of a few hours or less).

Multiple stressors may also have synergistic effects. For example, fish that experience temporary hearing loss or injury from acoustic stressors could be more susceptible to physical strike and disturbance stressors via a decreased ability to detect and avoid threats. Fish that experience behavioral and physiological consequences of ingestion stressors could be more susceptible to entanglement and physical strike stressors via malnourishment and disorientation. 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. Navy research and monitoring efforts include 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.

Although potential impacts on certain fish species from the Proposed Action may include injury or mortality, impacts are not expected to decrease the overall fitness of any given population. Mitigation measures designed to reduce the potential impacts are discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring). The potential impacts anticipated from the Proposed Action are summarized in Sections 3.9.4.2 (Endangered Species Act Determinations), with respect to each regulation applicable to fish.

3.9.4.2 Endangered Species Act Determinations

Table 3.9-7 summarizes the ESA determinations for each substressor analyzed. Pursuant to the ESA, the Navy has undertaken Section 7 consultation with NMFS for the proposed and ongoing activities in the AFTT Study Area under Alternative 2 (Preferred Alternative). For all substressors, training and testing activities are not likely to destroy or modify Atlantic salmon, smalltooth sawfish, or Gulf sturgeon critical habitat.

3.9.4.3 Essential Fish Habitat Determinations

Pursuant to the Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of sonar and other active acoustic sources (Atlantic herring only), explosives, and pile driving during training and testing activities may have minimal and temporary adverse effects on fish that occupy water column habitat by reducing the quality or quantity of water column (sound and electro-chemical environment) that constitutes Essential Fish Habitat or Habitat Areas of Particular Concern (U.S. Department of the Navy 2013). The use of electromagnetic devices during training and testing activities may have minimal and temporary adverse effects on fishes that occupy water column habitat by reducing the quality or quantity of water column electro-chemical environment) that constitutes Essential Fish Habitat or Habitat Areas of Particular Concern (U.S. Department of the Navy 2013). The AFTT Essential Fish Habitat Assessment states that individual stressor impacts were all either no-effect or minimal, and temporary in duration, depending on the stressor (U.S. Department of the Navy 2013).

Pursuant to the Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the Navy has undertaken consultation with NMFS for the proposed and ongoing activities in the AFTT Study Area under Alternative 2 (Preferred Alternative). The consultation is complete and NMFS concurred with the Navy’s Essential Fish Habitat Assessment.

Table 3.9-7: Summary of Endangered Species Act Determinations for Training and Testing Activities for Alternative 2 (Preferred Alternative)

Navy Activities and Stressors		Atlantic Salmon	Largetooth Sawfish	Smalltooth Sawfish	Shortnose Sturgeon	Gulf Sturgeon	Atlantic Sturgeon
Acoustic Stressors							
Sonar and Other Active Acoustic Sources	Training Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
	Testing Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
Explosives	Training Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect likely to adversely affect	May affect not likely to adversely affect	May affect likely to adversely affect	May affect likely to adversely affect
	Testing Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect likely to adversely affect	May affect not likely to adversely affect	May affect likely to adversely affect	May affect likely to adversely affect
Pile Driving	Training Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
	Testing Activities	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Swimmer Defense Airguns	Training Activities	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	Testing Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
Weapons Firing, Launch, and Impact Noise	Training Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
	Testing Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect

Table 3.9-7: Summary of Endangered Species Act Determinations for Training and Testing Activities for the Preferred Alternative (Continued)

Navy Activities and Stressors		Atlantic Salmon	Largetooth Sawfish	Smalltooth Sawfish	Shortnose Sturgeon	Gulf Sturgeon	Atlantic Sturgeon
Acoustic Stressors (Continued)							
Vessel Noise	Training Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
	Testing Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
Aircraft Noise	Training Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
	Testing Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
Energy Stressors							
Electromagnetic Devices	Training Activities	No effect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
	Testing Activities	No effect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
High Energy Lasers	Training Activities	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	Testing Activities	No effect	No effect	No effect	No effect	No effect	No effect
Physical Disturbance and Strike Stressors							
Vessels and In-Water Devices	Training Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
	Testing Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect

Table 3.9-7: Summary of Endangered Species Act Determinations for Training and Testing Activities for the Preferred Alternative (Continued)

Navy Activities and Stressors		Atlantic Salmon	Largetooth Sawfish	Smalltooth Sawfish	Shortnose Sturgeon	Gulf Sturgeon	Atlantic Sturgeon
Physical Disturbance and Strike Stressors (Continued)							
Military Expended Materials	Training Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
	Testing Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
Seafloor Devices	Training Activities	No effect	No effect	No effect	No effect	No effect	No effect
	Testing Activities	No effect	No effect	May affect not likely to adversely affect	May affect not likely to adversely affect	No effect	May affect not likely to adversely affect
Entanglement Stressors							
Fiber Optic Cables and Guidance Wires	Training Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
	Testing Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
Parachutes	Training Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
	Testing Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
Ingestion Stressors							
Munitions	Training Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
	Testing Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect

Table 3.9-7: Summary of Endangered Species Act Determinations for Training and Testing Activities for the Preferred Alternative (Continued)

Navy Activities and Stressors		Atlantic Salmon	Largetooth Sawfish	Smalltooth Sawfish	Shortnose Sturgeon	Gulf Sturgeon	Atlantic Sturgeon
Ingestion Stressors (Continued)							
Military Expended Materials Other Than Munitions	Training Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
	Testing Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
Secondary Stressors							
Secondary Stressors	Training Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect
	Testing Activities	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect	May affect not likely to adversely affect

Note: The scientific names of the listed species are as follows: Atlantic salmon (*Salmo salar*), largetooth sawfish (*Pristis pristis*), smalltooth sawfish (*Pristis pectinata*), shortnose sturgeon (*Acipenser brevirostrum*), Gulf sturgeon (*Acipenser oxyrinchus desotoi*), and Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*).

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3.10 CULTURAL RESOURCES

CULTURAL RESOURCES SYNOPSIS

The Navy considered all potential stressors and the following have been analyzed for submerged cultural resources:

- Acoustic (underwater explosions, sonic booms, and cratering from underwater detonations)
- Physical disturbance and strike (use of seafloor devices and deposition of military expended materials)

Preferred Alternative (Alternative 2)

Acoustic and physical stressors, as indicated above, would not affect submerged prehistoric sites and submerged historic resources in accordance with Section 106 of the National Historic Preservation Act because measures were previously implemented to protect these resources.

3.10.1 INTRODUCTION AND METHODS

3.10.1.1 Introduction

Cultural resources are found throughout the Atlantic Fleet Training and Testing (AFTT) Study Area (Study Area). The approach for the assessment of 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, historical architectural resources, and traditional cultural properties related to precontact (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 resources 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.

3.10.1.1.1 Identification, Evaluation, and Treatment of Cultural Resources

Procedures for the identification, evaluation, and treatment of cultural resources within state territorial waters (varies from 3 nautical miles [nm] in most states to 9 nm in Florida [Gulf coast only], Puerto Rico, and Texas) and United States (U.S.) territorial waters (within 12 nm) are contained in a series of federal and state laws and regulations, and agency guidelines. Archaeological, architectural, and Native American 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 [C.F.R.] Part 800). Historic properties, as defined by the National Historic Preservation Act, represent the subset of cultural resources listed in, or eligible for, inclusion in the National Register of Historic Places.

Section 106 of the National Historic Preservation Act 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 C.F.R. Part 800) specify a consultation process to assist in satisfying this requirement. Consultation with the appropriate State Historic Preservation Offices, the Advisory Council on Historic Preservation, Native American tribes, and the public and state and federal agencies as required by Section 106 of the National Historic Preservation Act and by government-to-government consultation required by Executive Order (EO) 13007 will be accomplished concurrently with the preparation of this Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) for the portion of the Proposed Action within state territorial waters (within 3 or 9 nm). Scoping letters for this EIS/OEIS were sent to appropriate State Historic Preservation Offices and 28 federally recognized Native American tribes on July 16, 2010. The draft EIS/OEIS was submitted to the appropriate State Historic Preservation Offices for review on April 12, 2013. This correspondence also requested concurrence with “No Historic Properties Affected” in accordance with Section 106 of the National Historic Preservation Act.

Additional regulations and guidelines for submerged historical resources include 10 United States Code (U.S.C.) § 113, Title XIV for the Sunken Military Craft Act; the Abandoned Shipwreck Guidelines prepared by the National Park Service (National Park Service 2007); and the Guidelines for Archeological Research Permit Applications on Ship and Aircraft Wrecks under the Jurisdiction of the Department of the Navy (32 C.F.R. 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 federal archeological program, developed by the National Park Service as a result of 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 (16 U.S.C. § 470a-2: International Federal activities affecting historic properties) 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 and 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 Organisation 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.

3.10.1.2 Methods

The approach for establishing current conditions is based on different regulatory parameters defined by geographical location. Within state territorial waters, the National Historic Preservation Act is the guiding mandate; within U.S. territorial waters, the National Environmental Policy Act is the primary mandate.

Under NEPA, an EIS/OEIS must address the adverse and beneficial effects of a proposed federal action on important historical and cultural aspects of our national heritage (40 C.F.R. § 1508.8) (here defined as resources eligible for or listed in the National Register of Historic Places). Under the implementing regulations of Section 106 of the National Historic Preservation Act, federal agencies must take into account the effects that an action would have on cultural resources listed in or eligible for inclusion in the National Register of Historic Places. The term "historic properties" is synonymous with National Register of Historic Places-eligible or listed archaeological, architectural, or traditional resources. Cultural resources not formally evaluated may also be considered potentially eligible (i.e., a consensus determination in consultation with the State Historic Preservation Office) and, as such, are afforded the same regulatory consideration as those resources listed in the National Register of Historic Places.

Historic properties are defined in the National Historic Preservation Act (16 U.S.C. § 470w(5)) as any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in the National Register, including artifacts, records, and material remains related to such a property or resource. Properties are evaluated for nomination to the National Register and for evaluating eligibility of properties using the following criteria (36 C.F.R. § 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 several of the seven aspects of integrity (location, design, setting, materials, workmanship, feeling, and association) to convey its significance and qualify it for the National Register of Historic Places.

The following are defined as cultural resources within U.S. territorial waters:

- 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)

3.10.1.2.1 Data Used

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 2008, 2009a, b), national and international shipwreck databases, the National Register Information System, 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 repetitiveness in data. Many federal agencies “share” data as well as secondary sources. However, 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.

3.10.1.2.2 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 (i.e., 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 to 393 feet (ft.) (100 to 120 meters [m]) 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 inches (in.) (10 millimeters [mm]) per year to as little as 0.04 in. (0.10 cm) 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 1977; Garrison et al. 1989; Pearson et al. 2003; Science Applications 1981). These studies were commissioned to establish baselines for submerged cultural resource management policy by agencies responsible for those resources (Research Planning 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 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 prehistoric and submerged historic resources (Coastal Environments 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.

Figure 3.10-1: Artifacts from a Submerged Prehistoric Resource
(Source: Florida Division of Historical Resources 2011a)

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, environmental obstructions to navigation, and by inshore areas (Research Planning 2004).

Historic shipwrecks (example provided in Figure 3.10-2), classified as archaeological resources, are numerous in the large marine ecosystems (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). Warships or other vessels used for military purposes at the time of their sinking retain sovereign immunity (e.g., German U-boats) (Figure 3.10-3). 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).

Figure 3.10-2: Submerged Historic Resource (Spanish Galleon)
(Source: Florida Division of Historical Resources 2011b)

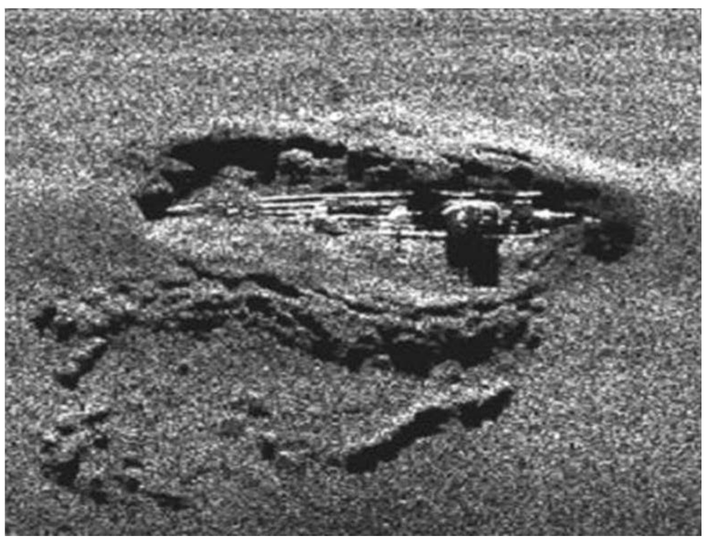

Figure 3.10-3: High-Resolution Side-Scan Sonar Image of Submerged Historic Resource (World War II Vessel)
(Source: Warren 2004)

Estimated numbers of historic submerged resources used in this EIS/OEIS are compiled from information obtained from various databases. Data changes are made yearly as exploration systems become more sophisticated and additional discoveries are made. 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.

3.10.1.3 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 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, the Newfoundland-Labrador Shelf, the Scotian Shelf, the Northeast U.S. Continental Shelf, the Southeast U.S. Continental Shelf, the Caribbean Sea, and the 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 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 (136 km) offshore at a depth of 130 ft. (40 m), 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) (Table 3.10-1; 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 within the large marine ecosystems exhibit moderate to high potential to contain submerged cultural resources (Burns 2011; Roberts 2012) (Table 3.10-1).

3.10.2.2.1 Cultural Resources Eligible for or Listed in the National Register of Historic Places

Three National Historic Landmarks or monuments, two National Register of Historic Places historic districts or Multiple Property Sites, and at least 12 individual resources considered eligible for or listed on the National Register of Historic Places are associated with the large marine ecosystems (Table 3.10-2).

Table 3.10-1: Cultural Resource Types in the Large Marine Ecosystems

Large Marine Ecosystem	Potential for Submerged Prehistoric Resource	Known wrecks, obstructions, occurrences, or sites marked as "unknown"					Resources Listed in or Eligible for the National Register of Historic Places or National Historic Landmarks
		Estimate in U.S. Territorial Waters (within 12 nm)	Estimate outside U.S. Territorial Waters (beyond 12 nm)	Total	Overall Density	Relative Probability	
West Greenland Shelf	No	Not Applicable	5	5	N/A	Low	No
Newfoundland-Labrador Shelf/ Scotian Shelf	No	Not Applicable	1,572	1,572	1 per 164 nm^2	Moderate	Not applicable
Northeast United States Continental Shelf	Yes	5,560	651	6,211	1 per 14 nm^2	Moderate	Yes
Southeast United States Continental Shelf	No	899	174	1,073	1 per 79 nm^2	Moderate	Yes
Caribbean Sea	No	74	130	204	N/A	Moderate	Yes
Gulf of Mexico	Yes	7,071	1,242	8,313	1 per 53 nm^2	Moderate	Yes
Pierside Locations	No	2	0	2	N/A	N/A	Yes
Total		**13,606**	**3,774**	**17,380**			

N/A: Not applicable; nm^2: square nautical miles

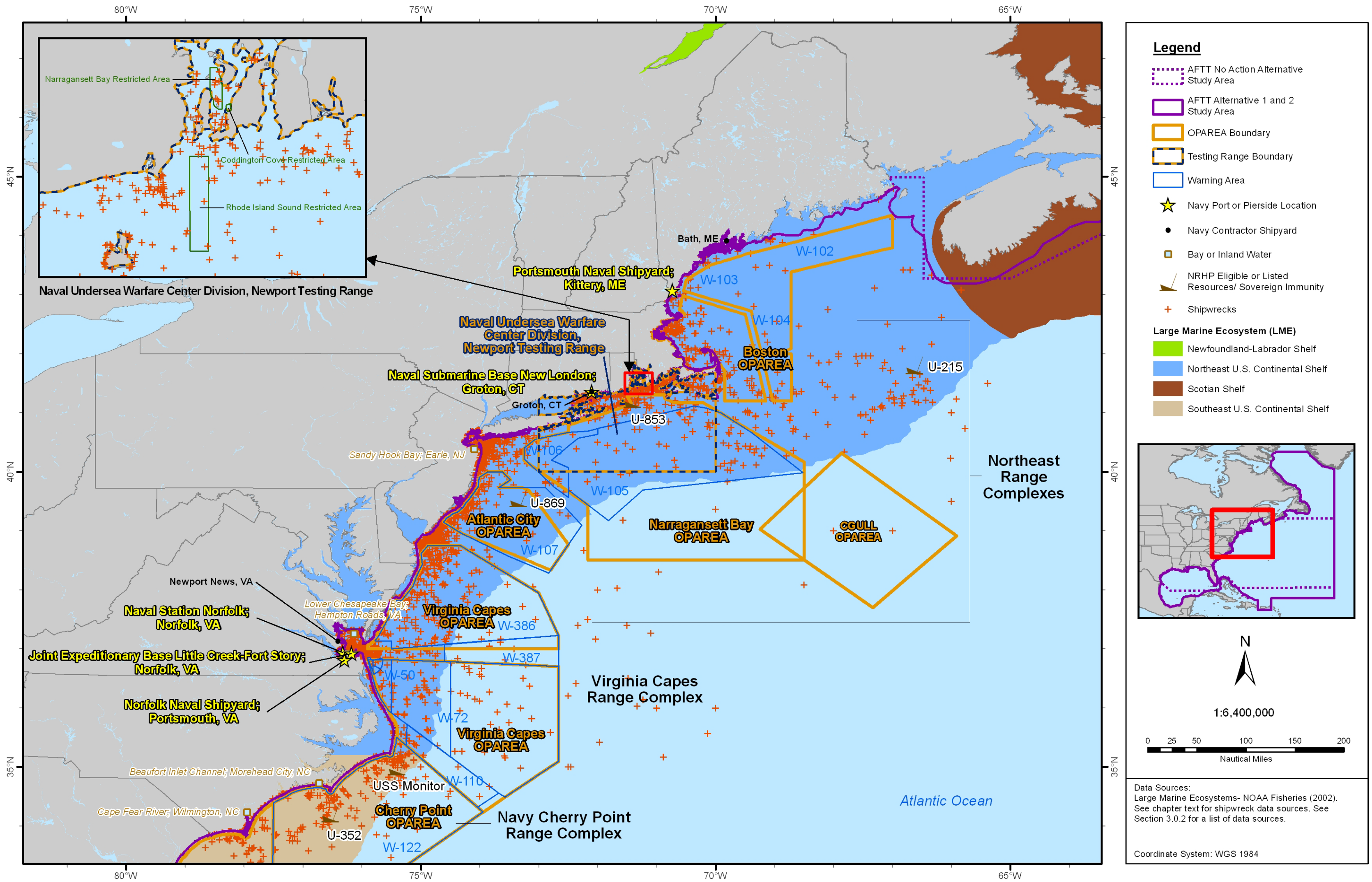

Figure 3.10-4: Known Wrecks, Obstructions, Occurrences, or Sites Marked as "Unknown" in the Northeast United States Continental Shelf Large Marine Ecosystem

AFTT: Atlantic Fleet Training and Testing; CT: Connecticut; ME: Maine; NC: North Carolina; NJ: New Jersey; NOAA: National Oceanic and Atmospheric Administration; NRHP: National Register of Historic Places; OPAREA: Operating Area; VA: Virginia

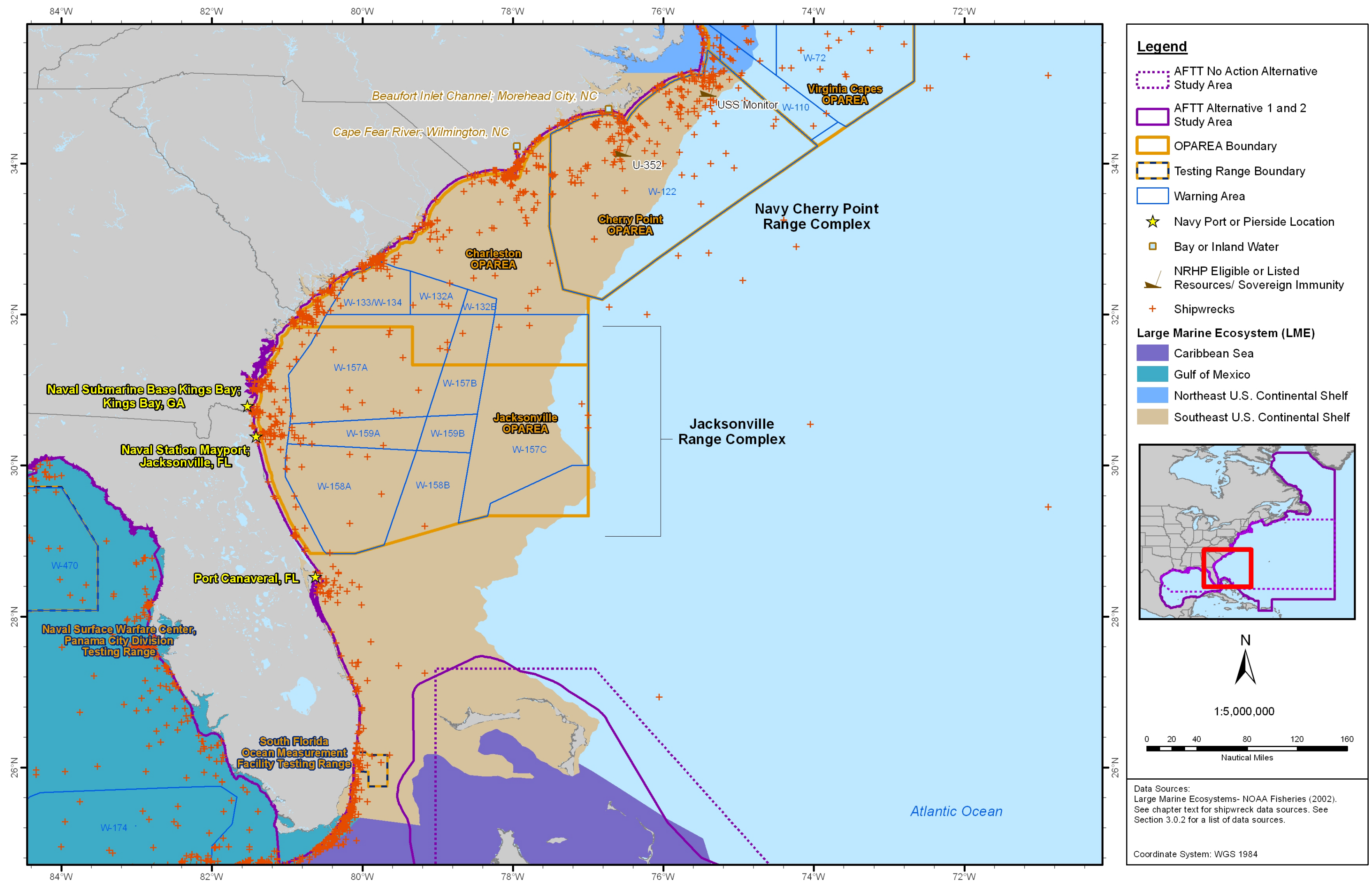

Figure 3.10-5: Known Wrecks, Obstructions, Occurrences, or Sites Marked as "Unknown" in the Southeast United States Continental Shelf Large Marine Ecosystem

AFTT: Atlantic Fleet Training and Testing; FL: Florida; GA: Georgia; NC: North Carolina; NOAA: National Oceanic and Atmospheric Administration; NRHP: National Register of Historic Places; OPAREA: Operating Area

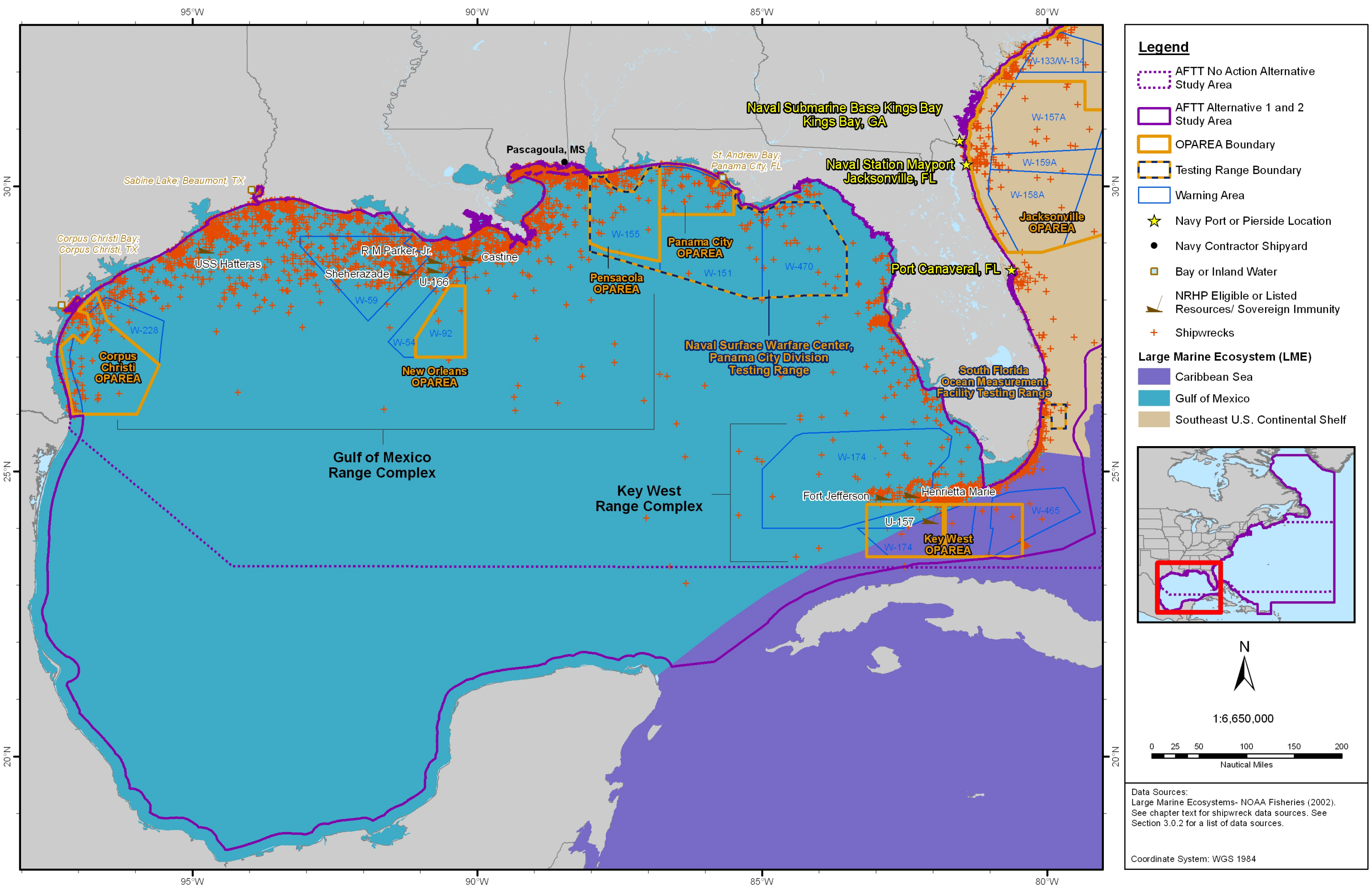

Figure 3.10-6: Known Wrecks, Obstructions, Occurrences, or Sites Marked as "Unknown" in the Southeast United States Continental Shelf, Caribbean Sea, and Gulf of Mexico Large Marine Ecosystems

AFTT: Atlantic Fleet Training and Testing; FL: Florida; GA: Georgia; MS: Mississippi; NOAA: National Oceanic and Atmospheric Administration; NRHP: National Register of Historic Places; OPAREA: Operating Area; TX: Texas

Table 3.10-2: 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	Naval Historical Center 2008, Neyland 2001, National Register Information System 2008, National Park Service 2008, USS Monitor Center 2008
USS Huron	Southeast U.S. Continental Shelf	Iron vessel, 1875–1877	Listed	No	North Carolina Office of State Archaeology 2010, National Register Information System 2010
Cape Fear Civil War Shipwrecks Discontiguous District	Southeast U.S. Continental Shelf	Civil War shipwrecks, 1861–1864 (16 blockade-running steamers, four Union vessels, and one Confederate vessel)	Historic District	No	Wilde-Ramsing and Angley 1985
Barge Wreck	Southeast U.S. Continental Shelf	19th-century barge	Listed	No	Burns 2011a
Cape Gull	Southeast U.S. Continental Shelf	United States Coast Guard cutter	Listed	No	Burns 2011a
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
SS Antonio Lopez	Caribbean	Spanish blockade runner, 1989	Listed	Yes	National Register Information System 2011
Fort Jefferson	Gulf of Mexico	Third System seacoast fortification, 1846	Listed	Yes	Morrison et al. 1974, Clark 2008

Table 3.10-2: 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
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 2011a
SS Tarpon	Gulf of Mexico	Cargo ship, 1896–1937	Listed	No	Florida Department of State 1997, Florida Department of State 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 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

3.10.2.2.2 Resources with Sovereign Immunity

German U-boats retain sovereign immunity and include the *U-869* (Uboat.net 2010c) and the *U-853* (Uboat.net 2010b) 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 2010a) in the Gulf of Mexico Large Marine Ecosystem.

3.10.2.3 Current Practices

Established baseline practices employed by the Navy include avoidance of underwater obstructions and overflight restrictions associated with the Tortugas Military Operations Area.

3.10.2.3.1 Avoidance of Obstructions

The Navy routinely avoids known obstructions, including submerged cultural resources such as historic shipwrecks, by providing the locations of known shipwrecks and other submerged cultural resources to operators prior to and well in advance of training and testing activities. Known obstructions are avoided to prevent damage to sensitive Navy equipment and vessels and to ensure the accuracy of training and testing exercises. In addition, ships will not anchor in areas known to contain submerged cultural resources.

In the event the Navy impacts a submerged historic property, it will immediately commence consultation with the appropriate State Historic Preservation Officer in accordance with 36 C.F.R. § 800.13(a)(3).

3.10.2.3.2 Tortugas Military Operations Area

The Tortugas Military Operations Area is not a traditional military operations 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 Military Operations Area is that 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.

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) potentially impact cultural resources of the Study Area. Tables 2.8-1 through 2.8-3 present the baseline and proposed training and testing activity locations for each alternative (including number of events and ordnance expended). Table F-1 in Appendix F (Training and Testing Activities Matrices) shows all 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 and that are analyzed include the following:

- Acoustic Stressors
  - Impacts from Explosives- Shock (pressure) waves from underwater explosions
  - Impacts from Explosives- Cratering
  - Impacts from Aircraft Noise- Vibration from sonic booms

- Physical Disturbance and Strike Stressors
  - Impacts from Military Expended Materials
  - Impacts from Seafloor Devices

The use of sonar does not affect the structural elements of historic shipwrecks, and no further analysis is required for cultural resources in this document. Archaeologists use multi-beam sonar and side-scan sonar as a regular practice in effectively exploring shipwrecks without disturbance. Based on the physics of underwater sound, the shipwreck would need to be very close (less than 22 ft. [6.5 m]) to the sonar sound source for the shipwreck to potentially experience any slight oscillations from the induced pressure waves. Any oscillations experienced at less than 22 ft. (6.5 m) would be negligible up to less than a few yards from the sonar source. This distance is smaller than the typical safe navigation and operating depth for most sonar sources and therefore is not expected to impact historic shipwrecks.

3.10.3.1 Acoustic Stressors

Acoustic stressors that have the potential to impact cultural resources are shock waves and vibrations from both underwater explosions and aircraft activities, and cratering created by underwater explosions. A shock wave and oscillating bubble pulses resulting from any kind of underwater explosion such as explosive torpedoes, missiles, bombs, projectiles, and mines could affect the exposed portions of submerged historical resources in the vicinity. Shock waves generated from underwater explosions would be episodic 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 size of the charge, distance from the historic shipwreck, water depth, and topography of the seafloor.

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 from Explosives – Shock Waves from Underwater Explosions

Explosions associated with bombs, missiles, and projectiles occur at or immediately below the ocean surface (within one meter). In addition, explosions associated with torpedoes and certain mine warfare events typically occur deeper in the water column. These types of explosions are within the water column and shock waves would not reach submerged historic resources on the seafloor. Underwater detonations of high explosives from other mine warfare events would occur near or on the seafloor. Shock waves have the potential to damage architectural features of submerged historic resources.

3.10.3.1.1.1 No Action Alternative

Training and Testing

Under the No Action Alternative, training and testing activities would continue within existing designated areas within the Northeast U.S. Continental Shelf, the Southeast U.S. Continental Shelf, the Caribbean Sea, and the Gulf of Mexico Large Marine Ecosystems. Because measures were previously implemented to protect submerged cultural resources, no impacts on submerged historic resources located in the large marine ecosystems are expected from shock waves created by underwater detonations.

3.10.3.1.1.2 Alternative 1

Training

Under Alternative 1, the number of explosive round detonations (high explosives) will increase within the Northeast U.S. Continental Shelf (Virginia Capes [VACAPES] Range Complex), the Southeast U.S. Continental Shelf (Navy Cherry Point and Jacksonville [JAX] Range Complexes), and the Gulf of Mexico (Key West and Gulf of Mexico [GOMEX] Range Complexes) Large Marine Ecosystems. Because measures were previously implemented to protect submerged cultural resources and overall types and locations of training activities are not expected to change from those undertaken in the No Action Alternative, no impacts on submerged historic resources located in the large marine ecosystems are expected from shock waves created by underwater detonations.

Testing

Under Alternative 1, the number of explosive round detonations (high explosives) associated with testing activities will increase within the Northeast U.S. Continental Shelf Large Marine Ecosystem (Naval Undersea Warfare Center Division, Newport Testing Range and VACAPES Range Complex) and the Gulf of Mexico Large Marine Ecosystem (Naval Surface Warfare Center, Panama City Division Testing Range). Because measures were previously implemented to protect submerged cultural resources and overall types and locations of testing activities are not expected to change from those undertaken in the No Action Alternative, no impacts on submerged historic resources located in the large marine ecosystems are expected from shock waves created by underwater detonations.

3.10.3.1.1.3 Alternative 2 (Preferred Alternative)

Training

Under Alternative 2, the number of explosive round detonations (high explosives) will increase from the No Action Alternative, but are the same as Alternative 1 within the Northeast U.S. Continental Shelf (VACAPES Range Complex), the Southeast U.S. Continental Shelf (Navy Cherry Point and JAX Range Complexes), and the Gulf of Mexico (Key West and GOMEX Range Complexes) Large Marine Ecosystems. Because measures were previously implemented to protect submerged cultural resources and overall types and locations of training activities are not expected to change from those undertaken in the No Action Alternative, no impacts on submerged historic resources located in the large marine ecosystems are expected from shock waves created by underwater detonations.

Testing

Under Alternative 2, the number of explosive round detonations (high explosives) will increase within Northeast U.S. Continental Shelf Large Marine Ecosystem (Naval Undersea Warfare Center Division, Newport Testing Range and VACAPES Range Complex) and the Gulf of Mexico Large Marine Ecosystem (Naval Surface Warfare Center, Panama City Division Testing Range). Because measures were previously implemented to protect submerged cultural resources and overall types and locations of testing activities are not expected to change from those undertaken in the No Action Alternative, no impacts on submerged historic resources located in the large marine ecosystems are expected from shock waves created by underwater detonations.

3.10.3.1.2 Impacts from Explosives – Cratering

Underwater explosions near or on the sea floor 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. Cratering could disrupt the horizontal patterning and vertical stratigraphy of submerged prehistoric sites and unrecorded historic resources, and could subsequently destroy those characteristics that would make them eligible for listing on the National Register of Historic Places.

3.10.3.1.2.1 No Action Alternative

Training

Under the No Action Alternative, mine warfare training activities would continue within existing designated areas within the Northeast U.S. Continental Shelf (VACAPES Range Complex), the Southeast U.S. Continental Shelf (Navy Cherry Point and JAX Range Complexes), and the Gulf of Mexico (GOMEX Range Complex) Large Marine Ecosystems. Because measures were previously implemented to protect submerged cultural resources, no impacts on submerged prehistoric sites or submerged historic resources located in the large marine ecosystems are expected from cratering created by deep underwater explosions.

Testing

Under the No Action Alternative, mine warfare testing activities would continue within existing designated areas within the Northeast U.S. Continental Shelf (VACAPES Range Complex) and the Gulf of Mexico (Naval Surface Warfare Center, Panama City Division Testing Range and GOMEX Range Complex) Large Marine Ecosystems. Because measures were previously implemented to protect submerged cultural resources, no impacts on submerged prehistoric sites or submerged historic resources located in the large marine ecosystems are expected from cratering created by deep underwater explosions.

3.10.3.1.2.2 Alternative 1

Training

Compared with the No Action Alternative, the number of high explosive rounds associated with mine warfare activities under Alternative 1 would increase within the Northeast U.S. Continental Shelf (VACAPES Range Complex), the Southeast U.S. Continental Shelf (Navy Cherry Point and JAX Range Complexes), the Caribbean Sea (Key West Range Complex), and the Gulf of Mexico (GOMEX Range Complex) Large Marine Ecosystems. Because measures were previously implemented to protect submerged cultural resources and overall types and locations of training activities are not expected to change from those undertaken in the No Action Alternative, no impacts on submerged prehistoric sites or submerged historic resources located in the large marine ecosystems are expected from cratering created by deep underwater explosions.

Testing

Compared with the No Action Alternative, the number of high explosive rounds associated with mine warfare activities under Alternative 1 would increase within the Northeast U.S. Continental Shelf (VACAPES Range Complex) and the Gulf of Mexico (Naval Surface Warfare Center, Panama City Division Testing Range and GOMEX Range Complex) Large Marine Ecosystems. Because measures were previously implemented to protect submerged cultural resources and overall types and locations of testing activities are not expected to change from those undertaken in the No Action Alternative, no impacts on submerged prehistoric sites or submerged historic resources located in the large marine ecosystems are expected from cratering created by deep underwater explosions.

3.10.3.1.2.3 Alternative 2 (Preferred Alternative)

Training

Under Alternative 2, the number of high explosive rounds and locations associated with mine warfare activities are the same as under Alternative 1 within the Northeast U.S. Continental Shelf (VACAPES Range Complex), the Southeast U.S. Continental Shelf (Navy Cherry Point and JAX Range Complexes), the Caribbean Sea (Key West Range Complex), and the Gulf of Mexico (GOMEX Range Complex) Large Marine Ecosystems. As concluded in Alternative 1, cratering created by deep underwater explosions is not expected to disturb or damage artifacts on the sea floor and archaeological deposits buried in the ocean sediments in the large marine ecosystems. Because measures were previously implemented to protect submerged cultural resources and overall types and locations of training activities are not expected to change from those undertaken in the No Action Alternative, no impacts on submerged prehistoric sites or submerged historic resources located in the large marine ecosystems are expected from cratering created by deep underwater explosions.

Testing

Compared with the No Action Alternative, the number of high explosive rounds associated with mine warfare activities under Alternative 2 would increase within the Northeast U.S. Continental Shelf (VACAPES Range Complex) and the Gulf of Mexico (Naval Surface Warfare Center, Panama City Division Testing Range and GOMEX Range Complex) Large Marine Ecosystems. The number of high explosive rounds increases slightly compared with Alternative 1. As concluded in Alternative 1, cratering created by deep underwater explosions is not expected to disturb or damage artifacts on the sea floor and archaeological deposits buried in the ocean sediments in the large marine ecosystems. Because measures were previously implemented to protect submerged cultural resources and overall types and locations of testing activities are not expected to change from those undertaken in the No Action Alternative, no impacts on submerged prehistoric sites or submerged historic resources located in the large marine ecosystems are expected from cratering created by deep underwater explosions.

3.10.3.1.3 Impacts from Aircraft Noise – Vibration from Sonic Booms

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).

3.10.3.1.3.1 No Action Alternative

Training

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 recent sonic boom study was conducted as part of the Key West Range Complex Environmental Assessment/Overseas Environmental Assessment (James et al. 2009). The study concluded that restored sections of Fort Jefferson are not susceptible to sonic boom damage (James et al. 2009). Because the exclusionary Military Operations Area exists around the Dry Tortugas National Park, and with the Navy's existing avoidance and protective measures enacted, sonic boom vibration has little potential for structural damage to historic structures and features associated with National Register of Historic Places-listed Fort Jefferson.

Testing

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.

3.10.3.1.3.2 Alternative 1

Training

As indicated in the No Action Alternative discussion, 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 either associated with activities generating sonic booms or contain susceptible cultural resources.

The supersonic activity under Alternative 1 is the same as under the No Action Alternative. Sonic boom vibration has little potential for structural damage to historic structures and features associated with National Register of Historic Places-listed Fort Jefferson.

Testing

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.

3.10.3.1.3.3 Alternative 2 (Preferred Alternative)

Training

As indicated in the No Action Alternative discussion, 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 increased aircraft activity in the Key West Range Complex under Alternative 2 compared with the No Action Alternative. However, the exclusionary Military Operations Area exists around the Dry Tortugas National Park, and with the Navy's existing avoidance and protective measures, sonic boom vibration has little potential for structural damage to historic structures and features associated with National Register of Historic Places-listed Fort Jefferson.

Testing

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.

3.10.3.1.4 Regulatory Conclusions of Acoustic Stressors

In accordance with Section 106 of the National Historic Preservation Act, acoustic stressors resulting from underwater explosions creating shock (pressure) waves or cratering of the seafloor during training and testing activities would not affect submerged cultural resources in state territorial waters from the No Action Alternative, Alternative 1, and Alternative 2 because the Navy previously implemented measures to protect these resources.

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. Expended materials, such as flares, projectiles, casings, target fragments, missile fragments, non-explosive practice munitions, munitions fragments, rocket fragments, ballast weights, sonobuoys, torpedo launch accessories, and mine shapes can be deposited on or in the vicinity of submerged prehistoric sites and historic resources. Heavier expended materials have the potential to damage intact fragile shipwreck features if they land on this resource type with velocity.

3.10.3.2.1 Impacts from Military Expended Materials

Deposition of non-explosive practice munitions, sonobuoys, and military expended materials other than ordnance may affect submerged cultural resources through possible sudden 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 cover 1,255,365 nm^2, and 53,436 known wrecks, obstructions, occurrences, or sites marked as "unknown" have been recorded. 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 (see Table 3.10-1) 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 munitions will be small objects and fragments that will slowly drift to the seafloor after striking the ocean surface. Larger and heavier objects such as non-explosive practice munitions and ship hulls could strike the ocean surface with velocity, but their acceleration will 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 historic resource could be impacted by damaging structural elements and artifacts in the regions with higher cultural resources probability and density.

If expended materials should sink in the vicinity of or on either type of submerged cultural resource, the expended materials would not affect the archaeological or historic characteristics of the submerged prehistoric site or the historic resource that would contribute to their eligibility for the National Register of Historic Places. The presence of expended materials on submerged sites would reflect post-depositional processes.

3.10.3.2.1.1 No Action Alternative

Training

Under the No Action Alternative, training activities would continue 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. Because of the size of the large marine ecosystems, it is unlikely these materials would come into contact with a submerged prehistoric site or a historic resource. If they should sink in the vicinity of either type of cultural resource, the expended materials would not affect the archaeological or historic characteristics of the submerged prehistoric site or the historic resource.

Testing

Under the No Action Alternative, testing activities would continue. Expended materials could be deposited on or in the vicinity of submerged prehistoric sites and known and unrecorded historic resources. Because of the size of the large marine ecosystems, it is unlikely these materials would come into contact with a submerged prehistoric site or a historic resource. If they should sink in the vicinity of either type of cultural resource, the expended materials would not affect the archaeological or historic characteristics of the submerged prehistoric site or the historic resource.

3.10.3.2.1.2 Alternative 1

Training

Under Alternative 1, the number of expended items from training activities would increase when compared with the No Action Alternative. Expended materials could be deposited on the seafloor or in the vicinity of submerged prehistoric sites and known and unrecorded historic resources. However, it is unlikely these materials would come into contact with a submerged prehistoric site or a historic resource. If they should sink in the vicinity of either type of cultural resource, the expended materials would not affect the archaeological or historic characteristics of the submerged prehistoric site or the historic resource.

Testing

Compared with the No Action Alternative, the number of expended items from testing activities under Alternative 1 would increase. Expended materials could be deposited on or in the vicinity of submerged prehistoric sites and known and unrecorded historic resources. However, it is unlikely these materials would come into contact with a submerged prehistoric site or a historic resource. If they should sink in the vicinity of either type of cultural resource, the expended materials would not affect the archaeological and historic characteristics of the submerged prehistoric site or the historic resource.

3.10.3.2.1.3 Alternative 2 (Preferred Alternative)

Training

Under Alternative 2, the number of expended items from training activities would increase from the No Action Alternative. Expended materials could be deposited on or in the vicinity of submerged prehistoric sites and known and unrecorded historic resources. However, it is unlikely these materials would come into contact with a submerged prehistoric site or a historic resource. If they should sink in the vicinity of either type of cultural resource, the expended materials would not affect the archaeological or historic characteristics of the submerged prehistoric site or the historic resource.

Testing

Under Alternative 2, the number of expended items from testing activities would increase from the No Action Alternative. Expended materials could be deposited on or in the vicinity of submerged prehistoric sites and known and unrecorded historic resources. However, it is unlikely these materials would come into contact with a submerged prehistoric site or a historic resource. If they should sink in the vicinity of either type of cultural resource, the expended materials would not affect the archaeological and historic characteristics of the submerged prehistoric site or the historic resource.

3.10.3.2.2 Impacts from Seafloor Devices

Any physical disturbance on the continental shelf and seafloor, such as precision 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. Precision anchoring could crush or snag structural elements of historic resources and damage intact sediments of submerged prehistoric sites. Divers are used to set bottom and moored mine anchors (blocks of concrete weighing several hundred pounds) in waters less than 150 ft. (45.7 m) deep and routinely avoid known obstructions, which include historic resources and any unrecorded obstructions they might encounter. Seafloor devices could disrupt the horizontal patterning and vertical stratigraphy of submerged prehistoric sites and historic resources as well as damage structural elements of the historic resources through crushing and snagging.

3.10.3.2.2.1 No Action Alternative

Training and Testing

Under the No Action Alternative, training and testing activities using seafloor devices would continue within existing designated areas within the Northeast U.S. Continental Shelf, the Southeast U.S. Continental Shelf, and the Gulf of Mexico Large Marine Ecosystems. Because measures were previously implemented to protect submerged cultural resources, no impacts on submerged prehistoric sites or submerged historic resources located in the large marine ecosystems are expected from the use of seafloor devices.

3.10.3.2.2.2 Alternative 1

Training

Compared with the No Action Alternative, the number of training activities using seafloor devices would increase under Alternative 1 in the Northeast U.S. Continental Shelf (VACAPES Range Complex), the Southeast U.S. Continental Shelf (Navy Cherry Point and JAX Range Complexes), and the Gulf of Mexico (GOMEX Range Complex) Large Marine Ecosystems. Because measures were previously implemented to protect submerged cultural resources, no impacts on submerged prehistoric sites or submerged historic resources located in the large marine ecosystems are expected from the use of seafloor devices.

Testing

Under Alternative 1, the number of testing activities using seafloor devices would increase from the No Action Alternative in the Northeast U.S. Continental Shelf (Northeast and VACAPES Range Complexes) and the Gulf of Mexico (Naval Surface Warfare Center, Panama City Division Testing Range) Large Marine Ecosystems. Because measures were previously implemented to protect submerged cultural resources, no impacts on submerged prehistoric sites or submerged historic resources located in the large marine ecosystems are expected from the use of seafloor devices.

3.10.3.2.2.3 Alternative 2 (Preferred Alternative)

Training

Under Alternative 2, the number of training activities using seafloor devices is the same as under Alternative 1 within the Northeast U.S. Continental Shelf (VACAPES Range Complex), the Southeast U.S. Continental Shelf (Navy Cherry Point and JAX Range Complexes), and the Gulf of Mexico (GOMEX Range Complex) Large Marine Ecosystems. Because measures were previously implemented to protect submerged cultural resources, no impacts on submerged prehistoric sites or submerged historic resources located in the large marine ecosystems are expected from the use of seafloor devices.

Testing

Under Alternative 2, the number of testing activities using seafloor devices would increase from the No Action Alternative in the Northeast U.S. Continental Shelf (Northeast and VACAPES Range Complexes) and the Gulf of Mexico (Naval Surface Warfare Center, Panama City Division Testing Range) Large Marine Ecosystems. Because measures were previously implemented to protect submerged cultural resources, no impacts on submerged prehistoric sites or submerged historic resources located in the large marine ecosystems are expected from the use of seafloor devices.

3.10.3.2.3 Regulatory Conclusions of Physical Disturbance and Strike Stressors

In accordance with Section 106 of the National Historic Preservation Act, physical stressors resulting from military expended materials and use of seafloor devices during training and testing activities would not affect submerged cultural resources in state territorial waters from the No Action Alternative, Alternative 1, and Alternative 2 because the Navy previously implemented measures to protect these resources.

3.10.4 SUMMARY OF POTENTIAL IMPACTS

3.10.4.1 Combined Impact of All Stressors

3.10.4.1.1 No Action Alternative

Training and testing activities associated with acoustic and physical stressors would not impact cultural resources because measures have been previously implemented to protect these resources.

3.10.4.1.2 Alternative 1

An increase in training and testing activities occurs with Alternative 1. Training and testing activities associated with acoustic and physical stressors would not impact cultural resources because measures have been previously implemented to protect these resources.

3.10.4.1.3 Alternative 2 (Preferred Alternative)

An increase in training and testing activities occurs with Alternative 2. Training and testing activities associated with acoustic and physical stressors would not impact cultural resources because measures have been previously implemented to protect these resources.

3.10.4.2 Regulatory Determinations

Table 3.10-3 summarizes effects in accordance with Section 106 of the National Historic Preservation Act for the No Action Alternative, Alternative 1, and Alternative 2. Consultation with the appropriate State Historic Preservation Office will continue, as needed, for cultural resources located within state territorial waters (within 3 nm) with the exception of Texas, Puerto Rico, and Florida (Gulf coast only), which have a 9-nm limit.

Table 3.10-3: Summary of Section 106 Effects on Cultural Resources

Alternative and Stressor	Section 106 Effects
No Action Alternative	
Acoustic Stressors	Acoustic stressors resulting from underwater explosions creating shock (pressure) waves and cratering of the sea floor would not affect submerged cultural resources because measures were previously implemented to protect these resources.
Physical Stressors	Physical stressors resulting from military expended materials and the use of seafloor devices during training and testing activities would not affect submerged cultural resources because measures were previously implemented to protect these resources.
Regulatory Determination	***No effect would occur to submerged cultural resources because measures were previously implemented to protect these resources.***
Alternative 1	
Acoustic Stressors	Acoustic stressors resulting from underwater explosions creating shock waves and cratering of the seafloor would not affect submerged cultural resources because measures were previously implemented to protect these resources.
Physical Stressors	Physical stressors resulting from military expended materials and use of seafloor devices during training and testing activities would not affect submerged cultural resources because measures were previously implemented to protect these resources.
Regulatory Determination	***Alternative 1 contains increases in the number of training and testing activities compared with the No Action Alternative. No effect would occur to submerged cultural resources because measures were previously implemented to protect these resources.***
Alternative 2	
Acoustic Stressors	Acoustic stressors resulting from underwater explosions creating shock waves and cratering of the seafloor would not affect submerged cultural resources because measures were previously implemented to protect these resources.
Physical Stressors	Physical stressors resulting from military expended materials and the use of seafloor devices during training and testing activities would not affect submerged cultural resources because measures were previously implemented to protect these resources.
Regulatory Determination	***Alternative 2 contains increases in the number of training and testing activities compared with the No Action Alternative. No effect would occur to submerged cultural resources because measures were previously implemented to protect these resources.***

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3.11 Socioeconomic Resources

SOCIOECONOMIC RESOURCES SYNOPSIS

The Navy considered all potential stressors and the following have been analyzed for socioeconomic resources:

- 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 impacts from availability of resources

Preferred Alternative (Alternative 2)

Impacts from the Preferred Alternative would be short term and temporary. Therefore, impacts on socioeconomic resources would be negligible.

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 (NEPA) state that when economic or social effects and natural or physical environmental effects are interrelated, the Environmental Impact Statement (EIS) will discuss these effects on the human environment (40 Code of Federal Regulations [C.F.R.] § 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 (i.e., employment, income, or revenue) and social conditions (i.e., 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

The primary area of interest for assessing potential impacts on socioeconomic resources is the United States (U.S.) territorial waters of the east and gulf coasts (seaward of the mean high water line to 12 nautical miles [nm]). Limited socioeconomic resources outside this area of interest (i.e., U.S. Exclusive Economic Zone between 3 and 200 nm from shore) are also described when relevant to human activities. This section describes the six socioeconomic elements associated with human activities and livelihoods in the Study Area.

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. The Federal Energy Regulatory Commission licenses hydropower projects. The Bureau of Ocean Energy Management has jurisdiction to issue leases, easements, and rights-of-way regarding hydropower projects on the outer continental shelf.

Several small-scale projects on rivers have been permitted in Maine, New Jersey, New York, and Massachusetts. A variety of academic institutions conduct research projects and do preliminary testing of water energy technology along the Atlantic coast. Their activities may include sea trials, small-scale prototype testing, and research that may use instruments like acoustic Doppler profile current sensors, digital recording sonar, underwater video, and still photography. Several wave and tidal energy projects in state waters are in the early permitting stages.

The U.S. Department of Agriculture and the U.S. 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). As a result, the number of water energy projects could increase. The Federal Energy Regulatory Commission has issued 15 tidal and 12 wave preliminary permits for projects on the east coast. Although a preliminary permit does not authorize construction, it allows the applicant to conduct investigations and secure data necessary to determine feasibility of the project.

The United States has no commercial offshore wave, tidal, or ocean thermal energy conversion generating capacity at this time. There are no hydropower projects operating or planned in the Study Area.

3.11.2.1.2 Wind

Wind energy is derived from the force of moving air. The United States has no offshore wind energy generating facilities at this time. *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 and U.S. Department of 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 2013a). 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 NEPA review (typically an EIS) is conducted, and plans for construction and operation are approved before beginning construction of individual wind power facilities.

Two wind energy projects, Cape Wind Energy and Fishermen's Atlantic City Windfarm, have been approved within the Study Area, but construction had not started as of March 2013. The 2011 and 2012 initiatives to speed offshore wind energy development off the Atlantic coast include activities in the following states:

- Maine (requests for leasing and notice of intent to prepare an EIS)
- Massachusetts (approval of the Cape Wind Energy Project and preparation of an environmental assessment for designating a wind energy area)
- Rhode Island (preparation of an environmental assessment for designating a wind energy area and notice of a proposed lease sale)
- New Jersey (issuance of interim policy leases and approval of the Fishermen's Atlantic City Windfarm)
- Delaware (executed a lease with Bluewater Wind Delaware)
- Maryland (call for information and nominations)
- Virginia (proposed lease sale notice)
- North Carolina (call for information and nominations)
- Georgia (submittal of an interim policy lease application and publication of a notice of intent to prepare an environmental assessment)
- Florida (preparation of an environmental assessment for an interim policy lease)

3.11.2.1.3 Oil and Gas

The Bureau of Ocean Energy Management administers Outer Continental Shelf Oil and Gas Leasing Programs. As of 1 April 2011, there were 6,323 active oil and gas leases totaling 33,905,799 acres in the Gulf of Mexico Continental Shelf Oil Region (Western Planning Area, 1,403 leases and 7,889,290 acres leased; Central Planning Area, 4,805 leases and 25,397,566 acres leased; and Eastern Planning Area, 115 leases and 618,944 acres leased) (Bureau of Ocean Energy Management 2011). Oil and gas exploration and production may occur in these areas of the Gulf of Mexico (Figures 3.11-1 and 3.11-2).

As a result of the lessons learned from the *Deepwater Horizon* oil spill, areas in the eastern Gulf of Mexico subject to the congressional moratorium on oil and gas exploration and production activities will not be considered for potential leasing before 2017. In addition, the Mid- and South Atlantic Planning Areas are no longer under consideration for potential development through 2017. The western, central, and eastern (portion not under the moratorium) Gulf of Mexico will continue to be considered for potential leasing before 2017 (U.S. Department of the Interior 2010).

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 31 December 2012 (Canadian Broadcasting Corporation 2008; Government of Nova Scotia 1999). Gas was discovered on the Sable Offshore Energy project offshore Nova Scotia in 1971; natural gas production began in 2000 and is continuing. The Sable project platforms are on the Scotian Shelf, approximately 124.3 mi. (200 km) off the coast of Nova Scotia. Gas production at this offshore location is accomplished with an undersea, offshore pipeline to link the production wells with gas markets. In 2010, the Sable Offshore Energy Project averaged daily production of approximately 300 million cubic feet ($ft.^3$) (0.849 million cubic meters [m^3]) of natural gas and 14,000 barrels of liquids (ExxonMobil 2011).

The Gulf of Mexico is the only part of the Study Area that contains energy production from oil and gas in U.S. territorial waters. Approximately 90 percent of all outer continental shelf leases are in the Gulf of Mexico. Louisiana produces more than 80 percent of the total United States' outer continental shelf oil and approximately 80 percent of the total United States' outer continental shelf natural gas (National Ocean Economics Program 2011b).

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. The Bureau of Ocean Energy Management is responsible for assessing the United States' outer continental shelf resources to determine if they can be developed in an environmentally sound manner. If these areas are leased, the Bureau of Ocean Energy Management regulates their activities to protect the environment and ensure safety of personnel and the public (Bureau of Ocean Energy Management 2013b).

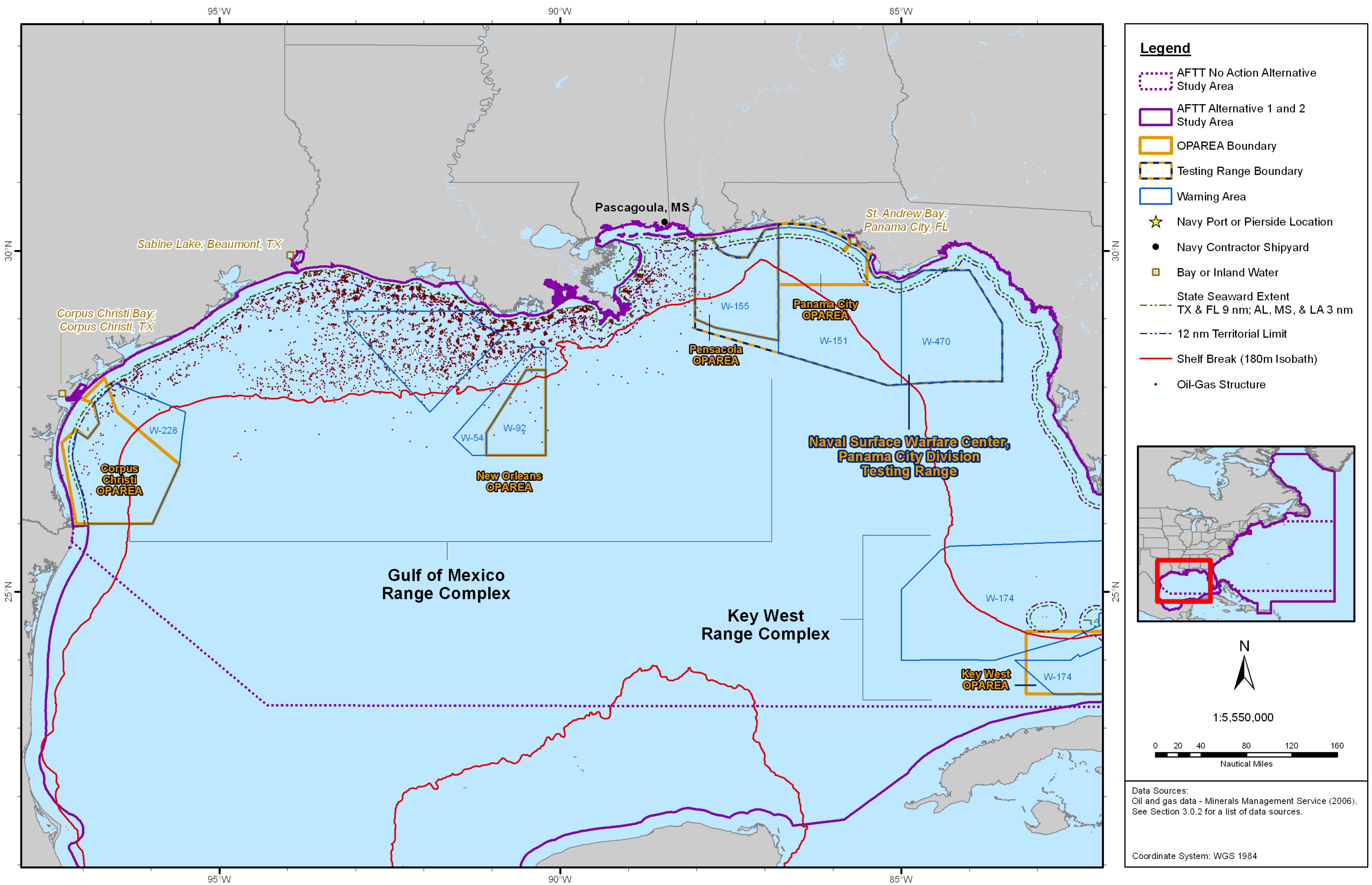

Figure 3.11-1: Oil and Gas Structures in the Gulf of Mexico

AFTT: Atlantic Fleet Training and Testing; AL: Alabama; FL: Florida; LA: Louisiana; m: meter; MS: Mississippi; nm: nautical mile; OPAREA: Operating Area; TX: Texas

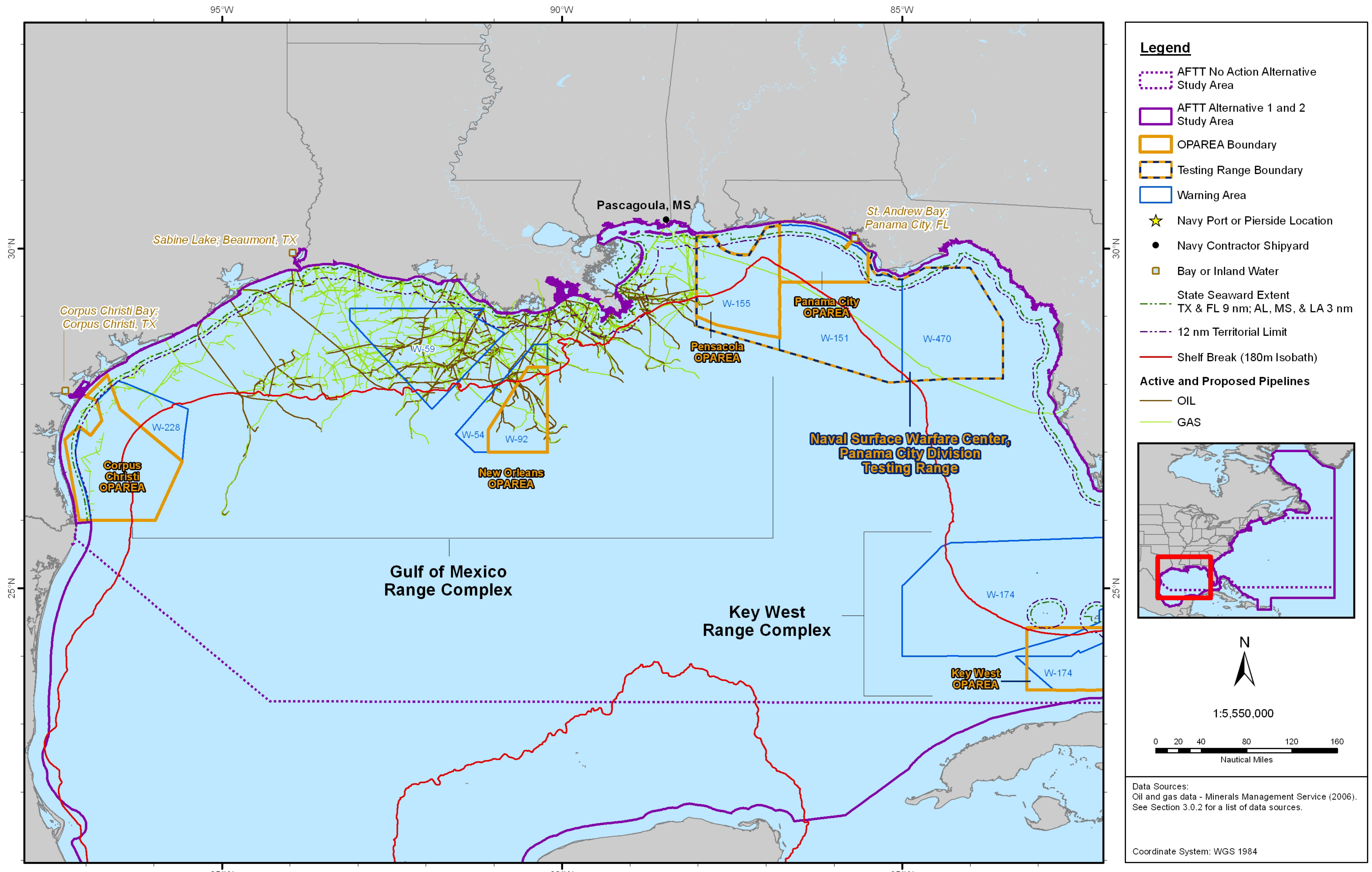

Figure 3.11-2: Active and Proposed Oil and Gas Pipelines in the Gulf of Mexico

AFTT: Atlantic Fleet Training and Testing; AL: Alabama; FL: Florida; LA: Louisiana; m: meter; MS: Mississippi; nm: nautical mile; OPAREA: Operating Area; TX: Texas

Two types of lease conveyances for sand and gravel and other nonenergy minerals are used by the Bureau of Ocean Energy Management: 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. Corresponding documentation is required for review of each lease request. The recent (2009-2012) marine mineral projects (Bureau of Ocean Energy Management 2013c) include the following state leases:

- Virginia (Dam Neck, Sandbridge, and Wallops Flight Facility)
- North Carolina (Bogue Banks)
- South Carolina (Charleston Offshore Dredged Material Disposal Site Sand Borrow Project)
- Florida (Patrick Air Force Base, Longboat Key, Martin County, Pinellas County, Duval County, and Brevard South Reach)
- Louisiana (Caminada Headlands, Cameron Parish, and Raccoon Island Phase B)

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 areas is generally compatible with civilian use, with Navy ships accounting for 3 percent of the total ship presence out to 200 nm (Center for Naval Analyses 2001). U.S. Navy vessels and aircraft that conduct activities not compatible with commercial or recreational transportation (e.g., weapons firing) typically occur in operating areas (OPAREAs) away from commercially used waterways and inside Special Use Airspace, as described in Section 3.11.2.3.2 (Air Transportation) as well as in transit and on testing ranges. Activities are communicated to vessel and aircraft operators by use of Notices to Mariners issued by the U.S. Coast Guard and Notices to Airmen issued by the Federal Aviation Administration. 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 (U.S. Department of the Navy 2011b) and Jacksonville (U.S. Department of the Navy 2011a). 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

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 C.F.R. 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 Section 3.11.3.1 [Accessibility] for a description of these areas). 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 east coast of the United States and the Gulf of Mexico are heavily traveled by marine vessels, with several commercial ports near U.S. Navy OPAREAs, as shown on Figure 3.11-3. Commercially used shipping lanes traverse the range complexes but, as referenced above, vessels are responsible for being aware of any temporary closures. Traffic flow controls are also implemented to ensure that harbors and ports-of-entry remain as uncongested as possible.

Recreational boats use ranges throughout the coastal waters, depending on season and weather conditions. There are over 12 million registered recreational boats in the United States. Recreational vessels registered in the 18 coastal states within the Study Area account for approximately 41 percent of this total (U.S. Department of Homeland Security 2008).

Sections 3.11.2.3.1.1 (Northeast Range Complexes) through 3.11.2.3.1.12 (Pierside Locations [Gulf of Mexico]) provide more detailed information on and accessibility to ocean transportation within the Study Area.

3.11.2.3.1.1 Northeast Range Complexes

The Boston OPAREA, Narragansett Bay OPAREA, and Atlantic City OPAREA 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 of the Boston OPAREA, Narragansett Bay OPAREA, and Atlantic City OPAREA. A portion of the CGULL OPAREA also overlaps the Narragansett Bay OPAREA.

Military Ocean Traffic

The Fleet Forces Atlantic 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 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.

Civilian Ocean Traffic

The northeastern Atlantic coast of the United States 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 within New England and mid-Atlantic ports in the United States, as well as traffic to eastern Canada and the eastern Atlantic Ocean. 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 OPAREA 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 OPAREA, leading to the major ports of New York City, New York; Newark, New Jersey; and Providence, Rhode Island. Similarly, the Atlantic City OPAREA 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 throughout the greater part of all the northeastern OPAREAs. Approximately 15 shipping lanes exist in this area, with the same representative routes as the northeastern United States, including the Atlantic-Puerto Rico Access and the Atlantic-Panama Access.

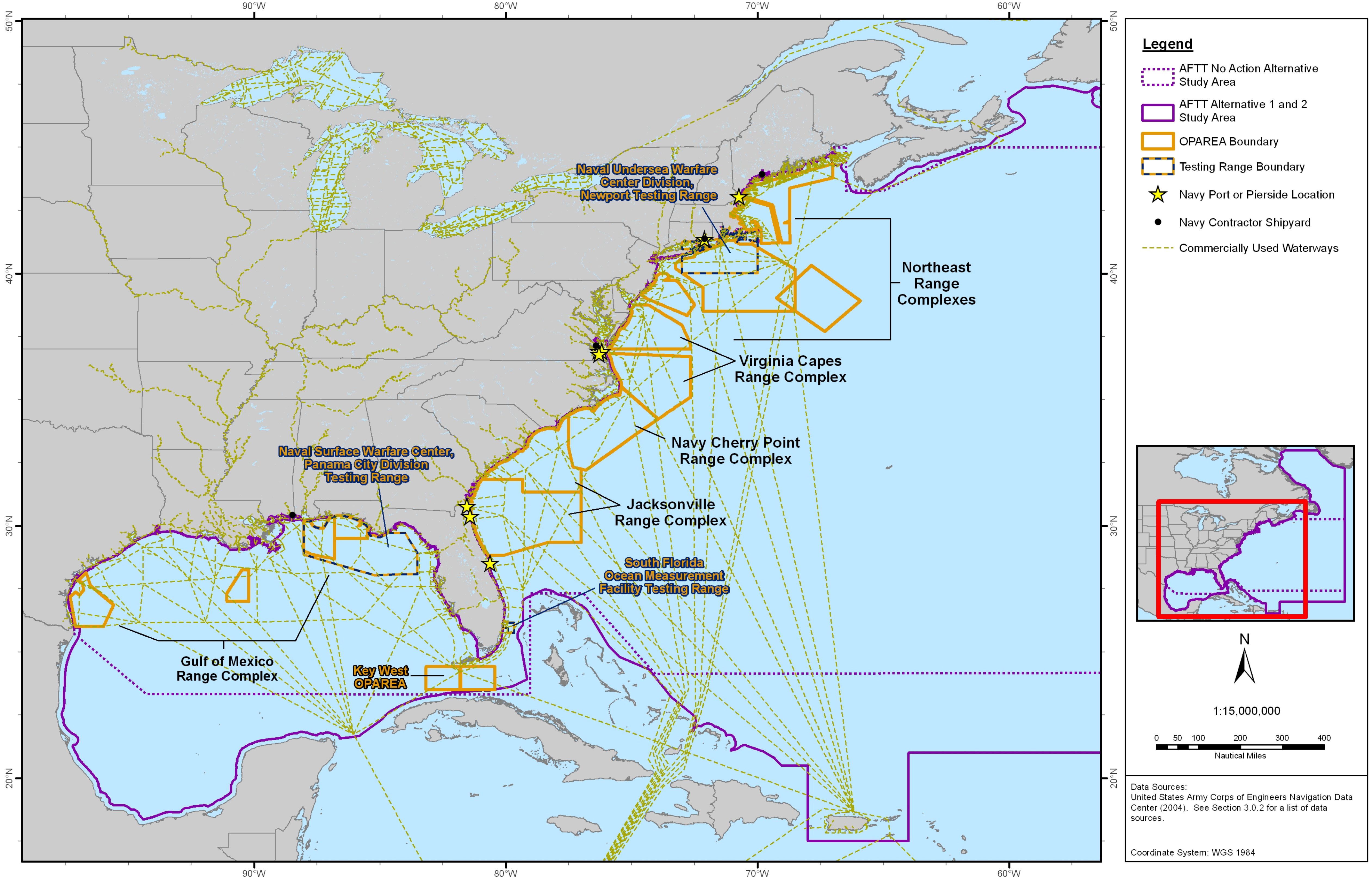

Figure 3.11-3: Commercially Used Waterways in the Study Area

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

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Some of the largest ports in the United States are near the northeastern OPAREAs. The port complex of New York City/Newark is ranked third in total trade in the United States, while New England's largest port, Boston, is ranked thirty-fourth in total trade in the United States, as determined by the American Association of Port Authorities (2009). The port complex of New York City/Newark has more scheduled services to a wider variety of trade lanes than any other port in North America. This port complex is the leading container volume gateway on the east coast of the United States. Since Halifax, Canada, is closer to northern Europe than any other major North American port, the complex is frequently used as the first inbound port or last outbound port in North America. The Boston port is rapidly becoming one of the fastest growing high-end cruise ship markets in the country.

Recreational boating off the northeastern Atlantic coast takes place from Maine to Maryland. Many sites known as fishing hotspots attract both recreational fishers and divers depending on the species and season of the year. Sales generated by recreational fishing in these nine coastal states, while mostly related to expenditures on durable fishing equipment, account for over $5.5 billion. These fishing hotspots and other dive sites (including artificial reefs and shipwrecks) are used throughout the year by recreational vessels, but use is highest during the summer. Most recreational boating occurs within a few miles of shore, while U.S. Navy activities normally occur farther offshore. The U.S. Navy would typically conduct exercises in and beyond federal waters, not in nearshore state waters, where recreational boaters could be present.

Many popular dive sites are located at the mouth of Massachusetts Bay within the Gerry E. Studds Stellwagen Bank National Marine Sanctuary. The 638-nm^2 marine sanctuary also offers several submerged shipwrecks (National Oceanic and Atmospheric Administration 2010a).

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 VACAPES 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 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 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 VACAPES 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, 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. The Chesapeake Bay Bridge-Tunnel crosses the mouth of Chesapeake Bay and connects the City of Virginia Beach to Cape Charles on the Eastern Shore.

The nearshore areas of the VACAPES OPAREA, in particular, are heavily traveled because they are near commercial ports in both Delaware and Virginia. Commercial ferries operate off the shores of Delaware, Maryland, Virginia and North Carolina. The lower Chesapeake Bay is home to the Port of Virginia in Norfolk, Virginia, the third busiest port facility on the east coast. In 2005, the port accommodated nearly 16 million short tons of imports and exports, amounting to 20 percent of the total of east coast maritime trade. The port handled 2,815 vessel calls, an average of about seven per day.

Recreational transportation activities offshore consist of game and sport fishing, charter boat fishing, sport diving, water skiing, swimming, dolphin and whale watching, sailing, and power cruising. The seven coastal states from Delaware to Florida maintained 2.6 million registered boats in 2008 (U.S. Department of Homeland Security 2008).

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 EIS/Overseas Environmental Impact Statement (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. (19 km) 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 (48-m) 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 (U.S. Department of Homeland Security 2002).

The Portsmouth Naval Shipyard in Kittery, Maine, is on Seavey Island in Portsmouth Harbor on the Piscataqua River. On average, 5 million metric tons of cargo transit the Piscataqua River annually. This cargo includes petroleum fuels and oils, gypsum, salt, asphalt, fiber optic telecommunications cable, and road salt. 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. (24 km) 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. (3.2 km) 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, seven miles 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. The Port of Virginia had 1,758 ship calls, transported 992,543 container units, and moved 14,908,490 short tons of cargo in 2009 (Virginia Port Authority 2010). Norfolk also offers cruise line and ferry services and is a port of call for several other cruise ships.

3.11.2.3.1.5 Navy Cherry Point Range Complex

Military Ocean Traffic

The Cherry Point OPAREA sea space covers 18,617 nm² off the east coasts of North Carolina and South Carolina. The Fleet Forces 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 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 boats range throughout the coastal waters, depending on season and weather conditions. North Carolina has 371,879 registered recreational boats and is ranked 11th nationwide (U.S. Department of Homeland Security 2008). There are 185 water access areas along the North Carolina coast (North Carolina Wildlife Resources Commission 2011).

Travel between the most popular cruising destinations in the area does not require traversing the OPAREA; however, larger recreational vessels, in particular sailboats and motor cruisers in the 50-ft. (15-m) and larger class, travel considerable distances offshore.

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 miles (26 km) 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 as the Graveyard of the Atlantic and contain thousands of other shipwrecks (National Oceanic and Atmospheric Administration 2010a).

3.11.2.3.1.6 Jacksonville Range Complex

Military Ocean Traffic

The JAX and Charleston OPAREAs, within the JAX Range Complex, cover 50,068 nm^2 of sea space off the coasts of North Carolina, South Carolina, Georgia, and Florida. The Fleet Forces Atlantic 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 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 JAX Range Complex.

Civilian Ocean Traffic

The nearshore areas of the JAX Range Complex, near the Jacksonville commercial port in particular, are heavily traveled. Recreational activities consist primarily of motorboating, game and sport fishing, jetskiing, waterskiing, shellfishing, 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 m (43 to 98 ft.) of water, 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 2010a). The associated Gray's Reef National Marine Sanctuary, which is used little by divers because of depth, strong current, and frequent turbidity, is 17.5 nm off Sapelo Island, Georgia, and encompasses 17 nm^2 of live-bottom habitat. Divers access the reef from numerous facilities between Savannah and Brunswick, Georgia (National Oceanic and Atmospheric Administration 2006).

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 operating areas.

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 nm^2 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 2005). 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 ordnance or jettison aerial targets unless the area is confirmed to be clear of nonparticipating civilian and military units (U.S. Department of the Navy 2005). Naval Air Station Key West issues Notices to Mariners and 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 2010).

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 2010). 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. (48.3 km) 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. Commercial cargo traffic moved over 2.5 million short tons of cargo in 2009 (Canaveral Port Authority 2010). 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 (GOMEX) Range Complex, including the Panama City, Pensacola, New Orleans, and Corpus Christi OPAREAs cover 17,520 nm^2 of ocean. The Fleet Forces 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 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 GOMEX Range Complex. The scheduling authority issues Notices to Mariners and 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.

Civilian Ocean Traffic

The Gulf of Mexico is heavily traveled by marine vessels, with several commercial ports near U.S. Navy OPAREAs. Two major ports within the GOMEX Range Complex, Corpus Christi and New Orleans, were ranked in the top 10 U.S. ports by tonnage (Research and Innovative Technology Administration 2009). Recreation activities offshore consist of game and sport fishing, charter boat fishing, sport diving, sailing, power cruising, and other recreational 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).

Popular sport diving sites within the area consist of natural and artificial reefs, including shipwrecks. In 1999, an estimated 83,780 dive trips occurred offshore between Texas and Alabama (Heitt and Milon 2002). A popular diving destination in the Gulf of Mexico is the Flower Garden Banks National Marine Sanctuary, which consists of the East and West Flower Garden Banks and Stetson Bank. The sanctuaries are approximately 130 mi. (209 km) northeast of the Corpus Christi OPAREA and approximately 190 mi. (306 km) west of the New Orleans OPAREA.

3.11.2.3.1.12 Pierside Locations (Gulf of Mexico)

One pierside location in the Gulf of Mexico is considered in this 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. Port of Pascagoula, at the mouth of the Pascagoula River, is the largest seaport in Mississippi and handles over 35 million tons of cargo annually (Jackson County Port Authority 2010).

3.11.2.3.2 Air Transportation

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 7400.8). 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 ordnance). 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 nonparticipating aircraft of potential danger.

- Air Traffic Controlled Assigned Airspace: Airspace that is Federal Aviation Administration-defined and is not over an existing OPAREA. This airspace is used to contain specified activities, such as military flight training, that are segregated from other instrument flight rules air 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 Facilities, Virginia Capes and 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 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

The U.S. Coast Guard enforces regulations of the U.S. commercial fishing fleet. The U.S. Commercial Fishing Industry Vessel Safety Act of 1988 requires that fishing industry vessels carry life rafts, radio beacons, and other safety equipment, depending on vessel size and the area of operation.

The U.S. Regional Fishery Management Council system was designed to allow regional, participatory governance by knowledgeable people with a stake in fishery management. The eight regional councils develop management plans for marine fisheries in waters seaward of state waters of their individual regions (Section 3.9, Fish).

Fishery Management Plans generally use 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.

The National Marine Fisheries Service (NMFS) incorporates commercial landing data into its Statistics and Economics Division databases from comprehensive surveys of all coastal states landings through a system of cooperative state and federal collection systems (National Marine Fisheries Service 2007). The term landing is defined by NMFS as the number or weight of fish caught, kept, and brought to shore.

The number of pounds of fish caught in the United States by commercial fishing efforts has been decreasing since 1994, although the total value of fish caught has increased (National Oceanic and Atmospheric Administration 2011a). However, while the number of pounds of fish caught in the continental United States has increased by 2.5 percent from 2009 to 2010, the pounds of fish caught in the 18 states within the Study Area has decreased by 8.2 percent during this time (National Marine Fisheries Service 2011). The National Marine Fisheries Service has determined that 16 percent of the managed U.S. marine fish stocks studied are subject to overfishing and that the rate of removal of these stocks is too high. The agency also determined that 23 percent of U.S. marine fish stocks studied are overfished, indicating that the population is too low or below a prescribed threshold (National Marine Fisheries Service 2010b).

Commercial fisheries take place seaward to 200 nm but also within state waters (out to 3 nm and 9 nm for Texas and Florida's west coast) and are managed by each state's natural resources or wildlife department. Similar to the structure of federal fisheries management, commercial species can have state quotas to manage landings, seasonal closures, and gear restrictions.

Table 3.11-1 summarizes the values of 2011 revenue from landings of the top commercial fishing species for each of the 18 coastal states in the Study Area. Additional information on commercially important species is in Sections 3.8 (Marine Invertebrates) and 2.9 (Fish).

Table 3.11-1: Value of Top Commercial Fish Caught off Coastal States in the Study Area, 2011

State	Species	Pounds	Landed Value
Maine	American lobster	104,693,316	$334,183,027
New Hampshire	American lobster	3,917,461	$16,337,205
Massachusetts	Sea scallop	33,016,384	$330,921,154
Rhode Island	Longfin squid	9,916,508	$11,342,043
	American lobster	2,752,505	$12,756,267
Connecticut	Silver hake	2,040,124	$1,615,219
	Sea scallops	1,318,181	$13,007,181
New York	Longfin squid	5,628,873	$7,248,539
New Jersey	Sea scallop	14,542,661	$142,482,039
Delaware	Blue crab	3,501,968	$4,819,108
Maryland	Blue crab	50,019,015	$59,137,787
Virginia	Menhaden	413,835,360	$32,977,529
	Sea scallop	8,260,487	$79,426,406
North Carolina	Blue crab	28,964,480	$18,016,541
South Carolina	White shrimp	1,683,238	$4,464,201
	Blue crab	5,415,179	$4,945,233
Georgia	White shrimp	3,373,483	$9,624,290
Florida (Atlantic coast)	White shrimp	6,056,017	$15,766,513
Florida (Gulf coast)	Caribbean spiny lobster	5,298,974	$35,589,513
Alabama	White shrimp	6,836,267	$20,864,688
	Brown shrimp	10,643,220	$20,096,416
Mississippi	Atlantic menhaden	266,774,325	$9,870,790
	Brown shrimp	7,025,206	$9,810,122
Louisiana	White shrimp	52,585,254	$98,342,143
	Menhaden	1,106,930,772	$93,546,503
Texas	Brown shrimp	59,394,882	$132,776,779

Source: National Marine Fisheries Service (2012)

3.11.2.4.2 Recreational Fishing

Sport fishing 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 2010, approximately 10 million recreational anglers across the United States took 71 million saltwater fishing trips around the country. Approximately 92 percent of these recreational angler trips were taken in the 18 states composing the Study Area (National Marine Fisheries Service 2011). Marine recreational fishing and their related expenditures in the mid-Atlantic and New England coastal states contributed $5.3 billion in economic activity for these coastal state economies (National Oceanic and Atmospheric Administration 2011b). Of the United States' key recreational species or species groups, herring (32 million fish), Atlantic croaker (8 million fish) and spotted seatrout (11 million fish) were most often caught by recreational anglers in 2010 (National Marine Fisheries Service 2010a). The most commonly caught non-bait species for Atlantic states were summer flounder, bluefish, Atlantic croaker, black sea bass, and scup. The species most commonly caught on Atlantic coast trips that fished primarily in federally managed waters were black sea bass, Atlantic cod, summer flounder, dolphinfish, and bluefish. The most commonly caught non-bait species for Gulf of Mexico states were spotted seatrout, red drum, sand seatrout, Atlantic croaker, and Spanish mackerel. The species most commonly caught on Gulf of Mexico trips that fished primarily in federally-managed waters were red grouper, red snapper, white grunt, gag, and yellowtail snapper (National Marine Fisheries Service 2010a).

Private or rental boat trips accounted for most of the fishing trips taken in the United States, accounting for 52 percent of total U.S. fishing trips or 44.5 million trips. This fishing mode made up the majority of the trips in the New England area (54 percent of trips), mid-Atlantic area (57 percent of trips), south Atlantic area (50 percent of trips), and Gulf of Mexico (60 percent of trips). Shore-based fishing trips accounted for 44 percent of total U.S. fishing trips, or 37 million trips. For-hire fishing boat trips accounted for 3.9 percent of total trips taken, with 3.4 million trips (National Marine Fisheries Service 2010a).

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. Fishermen 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.

The NMFS database for recreational fishing in 2010 indicates that in the Atlantic coast states, the largest harvests by weight were striped bass, bluefish, Atlantic cod, dolphinfish, and scup. In the Gulf of Mexico, the largest harvests by weight were red drum, spotted seatrout, sheepshead, black drum, Spanish mackerel, and sand seatrout (National Marine Fisheries Service 2010a). The most common fish species caught in each of the 18 coastal states in the Study Area are summarized in Tables 3.11-2 through 3.11-4.

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 able to reach the distance of the high seas would exceed most recreational boat sizes registered with the U.S. Coast Guard (U.S. Department of Homeland Security 2008).

The economic characteristics of recreational fishing for the 10-state mid-Atlantic area are summarized in Table 3.11-2.

Table 3.11-2: Economic Characteristics of Recreational Fishing in the Mid-Atlantic

Economic Factor	State									
	ME	NH	MA	RI	CT	NY	NJ	DE	MD	VA
Number of Recreational Anglers (million)	0.310	0.118	1.300	4.650	5.050	9.670	1.200	0.315	1.200	0.891
Percent of Anglers Living Outside the State	58	39	36	64	24	12	37	58	42	38
Percent of Saltwater Trips Taken by Private or Rental Boat	45	42	52	48	64	55	53	52	58	69
Percent of Recreational Fishing Conducted from the Shore	51	34	43	48	29	40	41	44	38	30
Percent of Saltwater Fishing Trips Taken by Charter Boat	4	23	5	4	3	5	6	4	4	2
Percent of Fishing Trips Taken in State Waters Inland or < 3 mi. (4.8 km) Offshore	96	75	91	98	~99	97	93	94	98	98
Percent of Fishing Trips Taken in U.S. Exclusive Economic Zone between 3 and 200 nm from Shore	3	24	8	1	<1	2	7	6	2	2
Jobs Supported by Recreational Fishing	1,286	357	5,900	1,467	4,884	5,766	9,612	1,462	7,244	5,564
Sales from Recreational Fishing (million)	$108	$39	$786	$166	$743	$875	$1,600	$224	$1,000	$619
Value-Added Impact from Recreational Fishing (million)	$57	$21	$427	$82	$427	$457	$820	$103	$504	$329
Fish Species Most Commonly Caught (common name)	Atlantic mackerel	Atlantic mackerel	Striped bass	Porgies (scup)	Striped bass	Summer flounder	Summer flounder	Drum (Atlantic croaker)	White perch	Drum (Atlantic croaker)

Source: National Marine Fisheries Service (2010a)

CT: Connecticut; DE: Delaware; km: kilometer; MA: Massachusetts; MD: Maryland; ME: Maine; mi.: mile; NH: New Hampshire; NJ: New Jersey; nm: nautical mile; NY: New York; RI: Rhode Island; VA: Virginia

Various organizations host recreational fishing tournaments throughout the year along the northeastern Atlantic coast from Maine to Virginia. Tournaments and derbies for bass, rockfish, tuna, and billfish are held for several days each.

The economic characteristics of recreational fishing for the four states in the southeast Atlantic area are summarized in Table 3.11-3.

Table 3.11-3: Economic Characteristics of Recreational Fishing in the Southeast Atlantic

Economic Factor	State			
	NC	SC	GA	FL (east coast)
Number of Recreational Anglers (million)	2.0	0.942	0.441	2.000
Percent of Anglers Living Outside the State	55	64	22	35
Percent of Saltwater Trips Taken by Private or Rental Boat	36	49	58	458
Percent of Recreational Fishing Conducted from the Shore	61	46	40	41
Percent of Saltwater Fishing Trips Taken by Charter Boat	4	5	1	1
Percent of Fishing Trips Taken in State Waters Inland or < 3 mi. (4.8 km) Offshore	93	92	94	86
Percent of Fishing Trips Taken in U.S. Exclusive Economic Zone between 3 and 200 nm from Shore	7	7	6	14
Jobs Supported by Recreational Fishing	22,000	5,500	2,500	35,000
Sales from Recreational Fishing (million)	$2,300	$488	$311	$4,000
Value-Added Impact from Recreational Fishing (million)	$1,100	$266	$162	$2,100
Fish Species Most Caught (common name)	Drum (Atlantic croaker)	Drum (Atlantic croaker)	Southern kingfish	Spotted sea trout

Source: National Marine Fisheries Service (2010a)
FL: Florida; GA: Georgia; km: kilometer; mi.: mile; NC: North Carolina; nm: nautical mile; SC: South Carolina

Various organizations host recreational fishing tournaments throughout the year along the southeastern Atlantic coast from Virginia to Florida. 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. Species fished include bluefin tuna, yellowfin tuna, wahoo, dolphinfish, big eye tuna, white marlin, and blue marlin.

As shown in Table 3.11-3, recreational fishing on the east coast of Florida supports the greatest number of jobs and generates the highest sales value of all the states along the southeast 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. 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).

Five states (Florida, Alabama, Mississippi, Louisiana, and Texas) are adjacent to the GOMEX Range Complex and the Naval Surface Warfare Center, Panama City Division Testing Range. The economic characteristics of recreational fishing in the Gulf of Mexico (including the west coast of Florida) are summarized in Table 3.11-4.

Table 3.11-4: Economic Characteristics of Recreational Fishing in the Gulf of Mexico

Economic Factor	State				
	FL (west coast)	AL	MS	LA	TX
Number of Recreational Anglers (million)	3.800	0.545	0.194	1.100	--
Percent of Anglers Living Outside the State	53	43	25	16	--
Percent of Saltwater Trips Taken by Private or Rental Boat	57	57	61	75	--
Percent of Recreational Fishing Conducted from the Shore	40	40	37	21	--
Percent of Saltwater Fishing Trips Taken by Charter Boat	4	3	1	4	--
Percent of Fishing Trips Taken in State Waters Inland or < 3 mi. (4.8 km) Offshore	93	91	97	97	--
Percent of Fishing Trips Taken in U.S. Exclusive Economic Zone between 3 and 200 nm from Shore	7	9	3	3	--
Jobs Supported by Recreational Fishing	54,600	4,700	2,900	25,600	25,500
Sales from Recreational Fishing (million)	$5,650	$455	$383	$2,300	$3,300
Value-Added Impact from Recreational Fishing (million)	$3,100	$235	$149	$1,200	$1,700
Fish Species Most Caught (common name)	Spotted sea trout	Drum (Atlantic croaker)	Spotted sea trout	Spotted sea trout	Spotted sea trout

Source: National Marine Fisheries Service (2010a)
AL: Alabama; FL: Florida; km: kilometer; LA: Louisiana; mi.: mile; MS: Mississippi; nm: nautical mile; TX: Texas
(--) Data Not Available

As shown in Table 3.11-4, recreational fishing on the west coast of Florida supports the greatest number of jobs and generates the highest sales value of all the states along the Gulf of Mexico. There were 3.2 million resident recreational fishermen who took fishing trips in the Gulf of Mexico in 2008. Almost 92 percent of those anglers were residents of a regional coastal county. Of the 24 million fishing trips taken in 2008, over 60 percent were taken from a private or rental boat. The most commonly caught key species or species groups were spotted sea trout, with 32.6 million fish harvested or released in 2008. This key species accounted for 49 percent of fish caught by anglers in the Gulf of Mexico (National Marine Fisheries Service 2010a).

Three major fishing tournaments are held each year in the eastern GOMEX Range Complex: two in Orange Beach, Alabama, and one in Panama City, Florida. The Panama City event is part of the World Billfish Series and draws approximately 10,000 spectators (National Marine Fisheries Service 1999). Major fishing tournaments in the western GOMEX Range Complex occur from Venice, Louisiana, to South Padre Island, Texas. These events occur over the weekend, and participants target popular fishing locations. Most fishing takes place on artificial reefs and at hotspots like canyons and seamounts. Species fished include bluefin tuna, yellowfin tuna, wahoo, dolphinfish, big eye tuna, white marlin, and blue marlin.

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 Oceanic and Atmospheric Administration 2010b). 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 overall U.S. and world aquaculture production. Total U.S. aquaculture production is about $1 billion annually, compared to world aquaculture production of about $70 billion. Only about 20 percent of U.S. aquaculture production is marine species. The largest single sector of the U.S. marine aquaculture industry is molluscan shellfish culture (oysters, clams, mussels), which accounts for about two-thirds of total U.S. marine aquaculture production, followed by salmon (about 25 percent) and shrimp (about 10 percent). Current production takes place mainly on land, in ponds, and in coastal waters under state jurisdiction (National Oceanic and Atmospheric Administration 2012).

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 2007, sales of aquaculture products in the United States accounted for $1.4 billion. The export of shellfish (shrimp, oysters, mussels, and clams) and frozen Atlantic salmon, much of it cultivated in the Atlantic and Gulf coastal states, accounted for over 13 percent of this revenue (U.S. Department of Agriculture 2005).

Most aquaculture farms within the Study Area are located in state waters. Based on 2007 census data compiled by the U.S. Department of Agriculture (2005), aquaculture operations in the 18 states of the Study Area represent approximately 58 percent of total aquaculture operations in the United States, with over 11 percent of these farms in Louisiana.

Massachusetts and New Hampshire are conducting 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 2008). The University of New Hampshire’s Atlantic Marine Aquaculture Center has been raising finfish in the open ocean since 1999 for noncommercial purposes. The demonstration site is 6 mi. (9.6 km) off the coast of New Hampshire.

Atlantic salmon are cultivated in coastal waters off the coast of Maine. The 2011 harvest of 24 million pounds attributed 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 and 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 acres (50 hectares) are leased for aquaculture production (Rice and 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 VACAPES 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 and Oesterling 2009). 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. Approximately 41 percent of eastern oyster farms in the United States are located in Texas, which accounts for nearly 90 percent of foodsize saltwater shrimp sold in the country. Louisiana sells approximately 87 percent of the eastern oysters produced in the United States, with approximately 34 percent of farms located in this state (U.S. Department of Agriculture 2005).

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, snorkeling, diving, and sight-seeing (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. Table 3.11-5 (Tourism Data Summary by State) presents the available data for the overall economic impact of tourism on the coastal states within the Study Area. These data include all aspects of a state’s tourism industry and are not limited to coastal counties or ocean-related activities.

Table 3.11-5: Tourism Data Summary by State, 2008

State	Total Expenditures (in billions)	Impact on State Economy (in millions)	Direct Jobs	Total Jobs (direct + indirect)	Wages (in billions)
Alabama	$9.6	$702	--	169,000	$3.7
Connecticut	--	--	--	--	--
Delaware	--	$1.5	--	--	--
Florida	$65.2	$3.9	1,007,000	--	--
Georgia	$20.8	$1.557	--	241,500	$6.3
Louisiana	$9.3	--	--	101,700	$1.9
Maine	$5.8	--	--	--	--
Maryland	--	--	--	--	--
Massachusetts	$15.6	--	--	128,000	$3.7
Mississippi	$6.0	--	85,000	115,790	$2.56
New Hampshire	$4.51	$11.5	62,477	--	$1.5
New Jersey	$38.8	$27.9	--	443,094	--
New York	--	--	--	--	--
North Carolina	$20.2	$15.6	--	326,000	$9.0
Rhode Island	$5.73	$2.26	--	45,538	--
South Carolina	$18.4	$1.2	115,000	185,873	$4.9
Texas	$60.4	--	--	542,000	$16.6
Virginia	$19.2	$2.5	--	210,000	$4.4

Sources: (Alabama Tourism Department 2009; Davidson-Peterson Associates 2009; Dean Runyan Associates 2010; Goss 2010; IHS Global Insight Inc. 2009; Massachusetts Office of Travel and Tourism 2009; Mississippi Development Authority/Tourism Division 2009; North Carolina Department of Commerce 2010; Tourism Economics 2010; U.S. Travel Association 2009, 2010; Virginia Tourism Corporation 2010; Visit Florida 2010)
(--) Data Not Available

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 (Ocean Economy Data for the Tourism and Recreation Sector by State) contains ocean economy data by state specific to the tourism and recreation sector for 2004. The table shows the impact of the tourism and recreation industry in coastal counties on states' employment and gross domestic product.

Table 3.11-6: Ocean Economy Data for the Tourism and Recreation Sector by State, 2004

State	Gross Domestic Product	Percent Gross Domestic Product	Employment	Percent Employment
Alabama	$354,485,500	21	13,981	63
Connecticut	$1,323,004,100	50	36,612	75
Delaware	$373,863,400	76	12,997	83
Florida	$10,721,166,200	70	262,643	84
Georgia	$690,828,500	62	19,739	75
Louisiana	$2,164,629,100	18	61,495	55
Maine	$966,728,600	50	30,603	67
Maryland	$1,119,400,700	46	35,014	67
Massachusetts	$2,080,336,200	59	54,062	77
Mississippi	$209,650,800	13	8,671	29
New Hampshire	$253,422,100	35	8,337	60
New Jersey	$2,198,637,500	47	58,787	66
New York*	$12,197,767,500	4	227,974	90
North Carolina	$868,232,500	50	31,933	79
Rhode Island	$869,969,700	70	23,416	79
South Carolina	$1,499,943,200	80	38,301	87
Texas	$1,913,357,200	23	69,533	61
Virginia	$1,432,917,800	51	46,827	51

Source: National Ocean Economics Program (2010a)

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 recreation.

* Includes data from counties adjacent to the Great Lakes.

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 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 18 m (59 ft.). More experienced divers are generally limited to 30 m (98 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. (15.2 to 27.4 m) (Associated Oceans 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 Connecticut (Groton, Stony Creek, and Niantic), Maine (New Harbor), Massachusetts (Cape Cod), and Rhode Island (Newport).

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.

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 2.8-1 through 2.8-3 present the baseline and proposed training and testing activity locations for each alternative (including number of events and ordnance expended). Each socioeconomic resource stressor is introduced, analyzed by alternative, and analyzed for training and testing activities. Table F-3 in Appendix F (Training and Testing Activities Matrices) shows the human 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)

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., livelihoods) 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 fiscal 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 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 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 recreation and fishing, aquaculture, tourism, and 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 on Figures 3.11-4 through 3.11-7. 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 and restricted zones listed in the Code of Federal Regulations and presented by section number on Figures 3.11-4 through 3.11-7 may be closed to the public full time or intermittently, as stated in the regulations (33 C.F.R. §§ 334.10-1490).

When training or testing activities that require specific areas to be free of nonparticipating vessels and aircraft due to public safety concerns are scheduled, the Navy requests that the U.S. Coast Guard and Federal Aviation Administration issue Notices to Mariners and Notices to Airmen, respectively. Many training and testing activities occur in established restricted or danger areas as published on navigation and aeronautical charts. Some frequently used areas have standing Notices to Mariners and Notices to Airmen to allow real-time, immediate use.

As an environmental stressor on most socioeconomic resources for human activities in marine environments, changes in accessibility from Navy training and testing activities would essentially be the same as current conditions. If access is hindered to the extent that equipment cannot be monitored or used, 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).

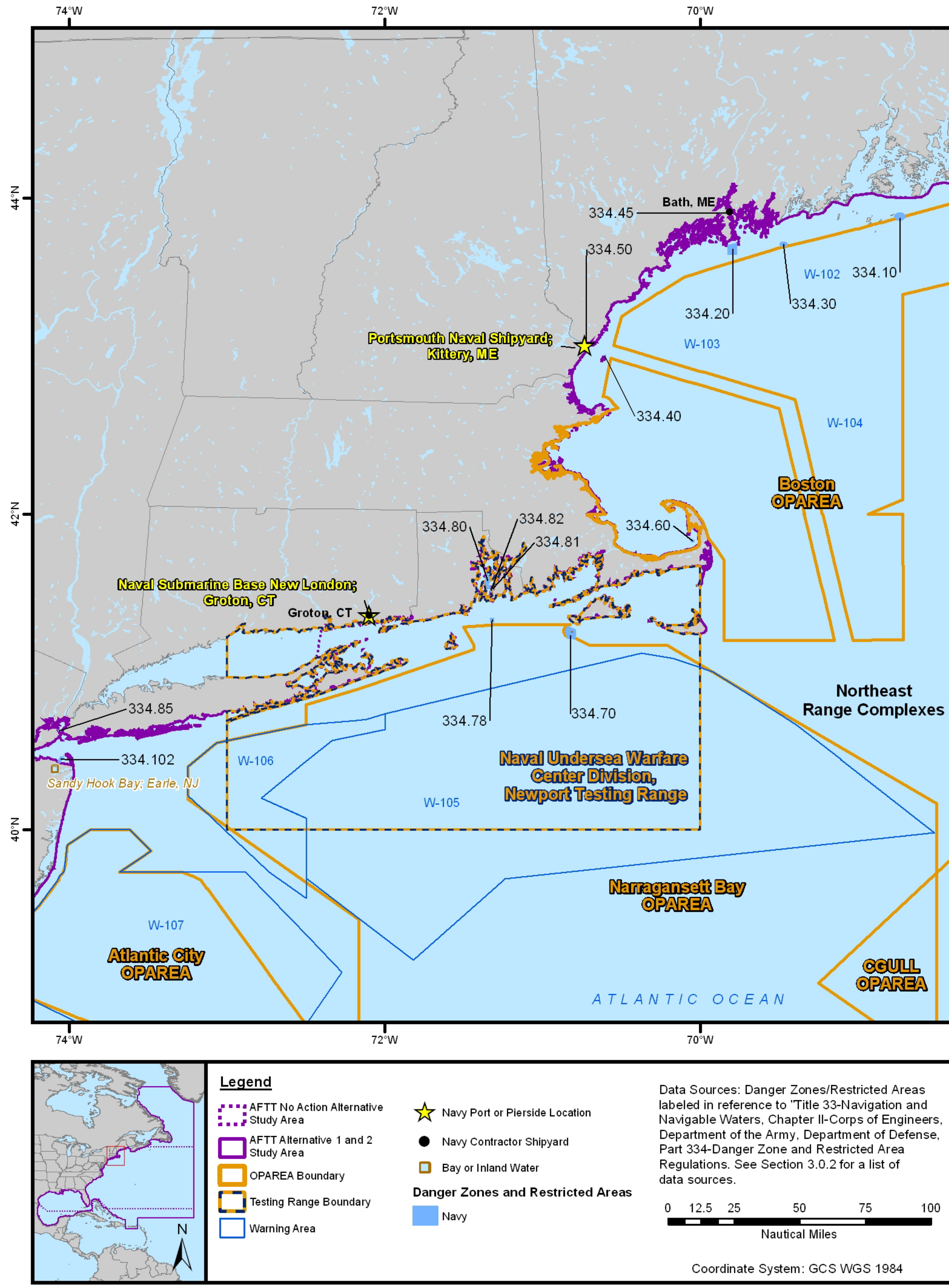

Figure 3.11-4: Danger Zones and Restricted Areas in the Northeast Atlantic Ocean

AFTT: Atlantic Fleet Training and Testing; CT: Connecticut; ME: Maine; NJ: New Jersey; OPAREA: Operating Area

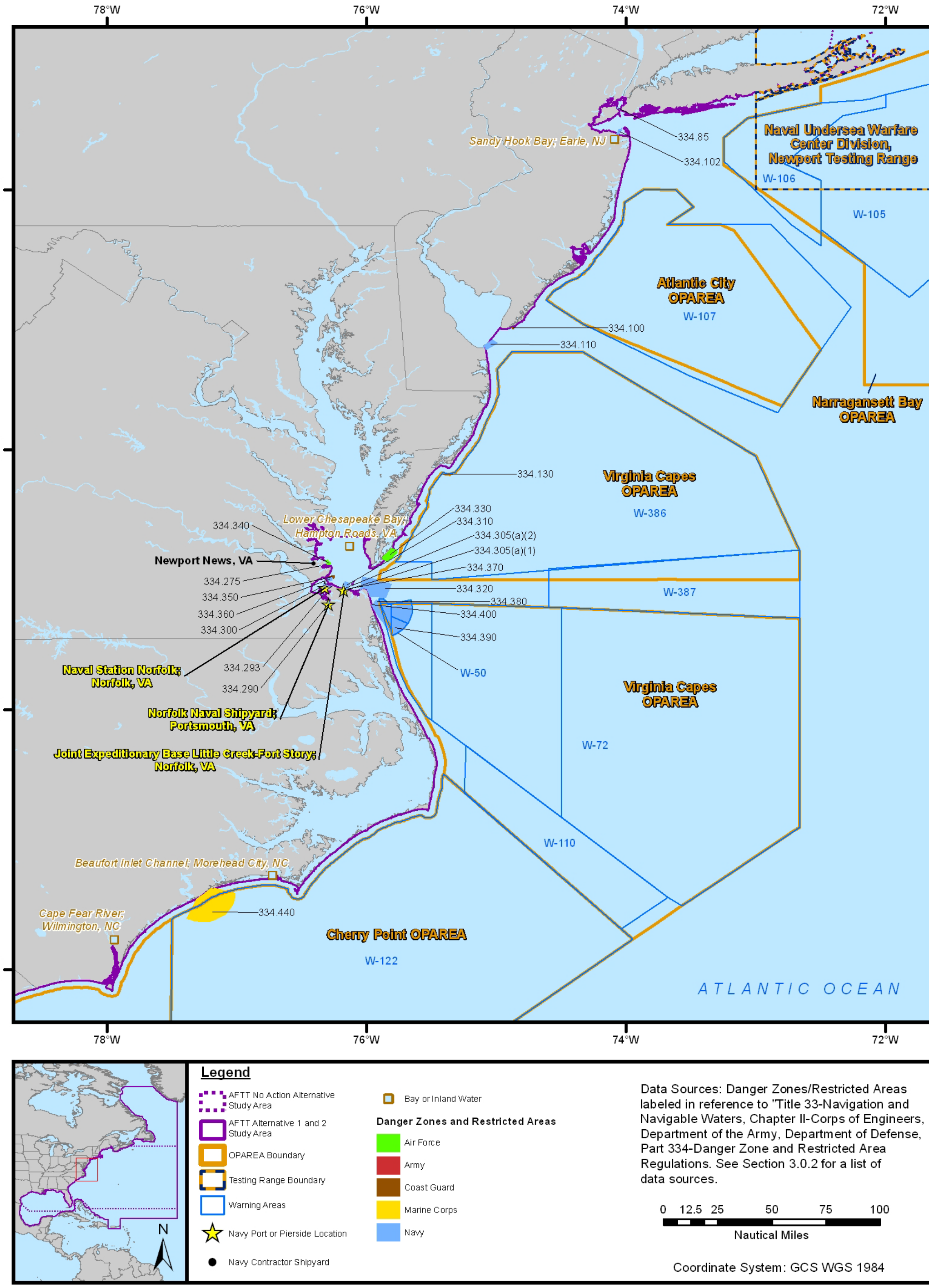

Figure 3.11-5: Danger Zones and Restricted Areas in the Mid-Atlantic Ocean

AFTT: Atlantic Fleet Training and Testing; NC: North Carolina; NJ: New Jersey; OPAREA: Operating Area; VA: Virginia

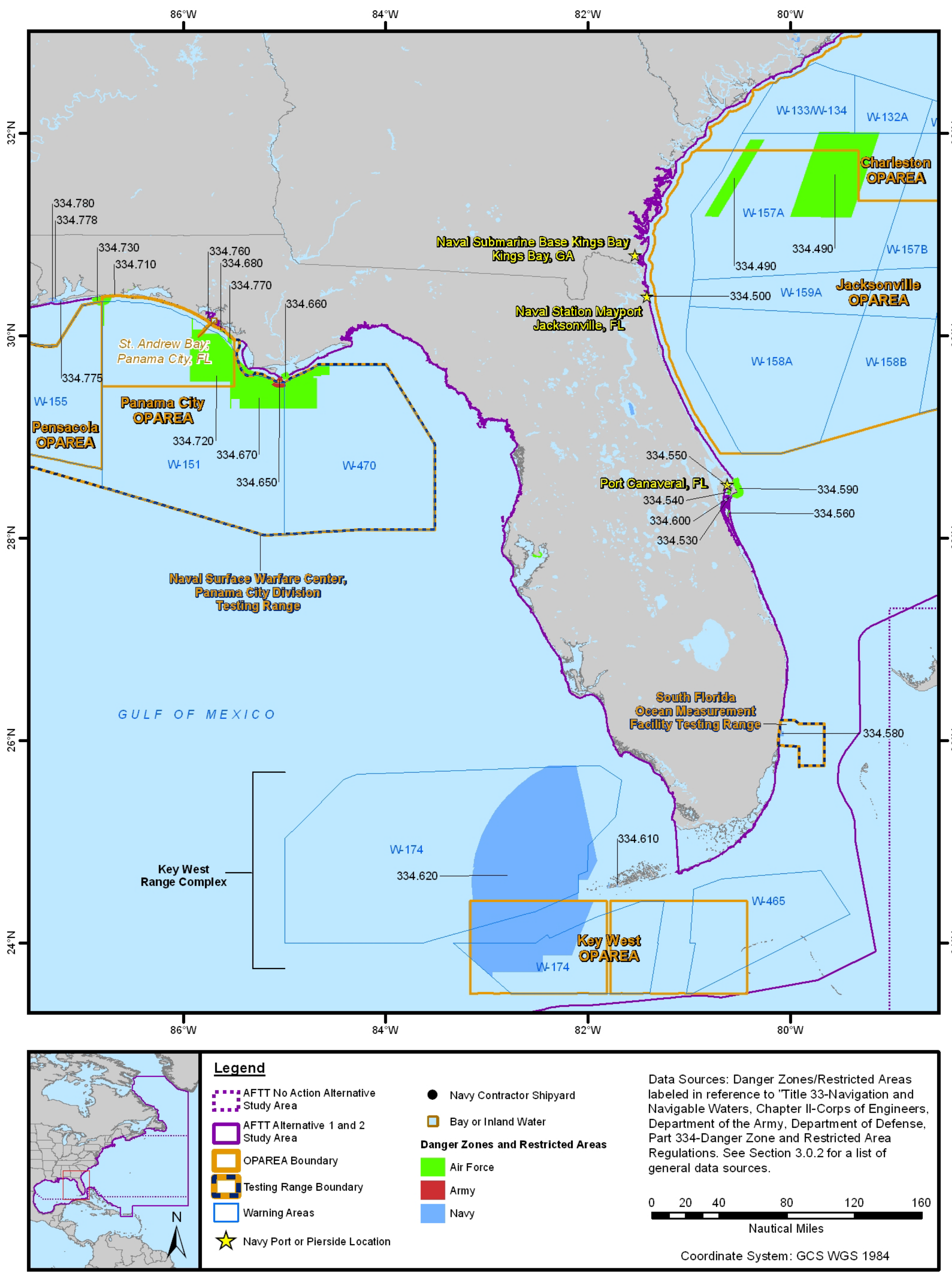

Figure 3.11-6: Danger Zones and Restricted Areas in the Southeast Atlantic Ocean

AFTT: Atlantic Fleet Training and Testing; FL: Florida; GA: Georgia; OPAREA: Operating Area

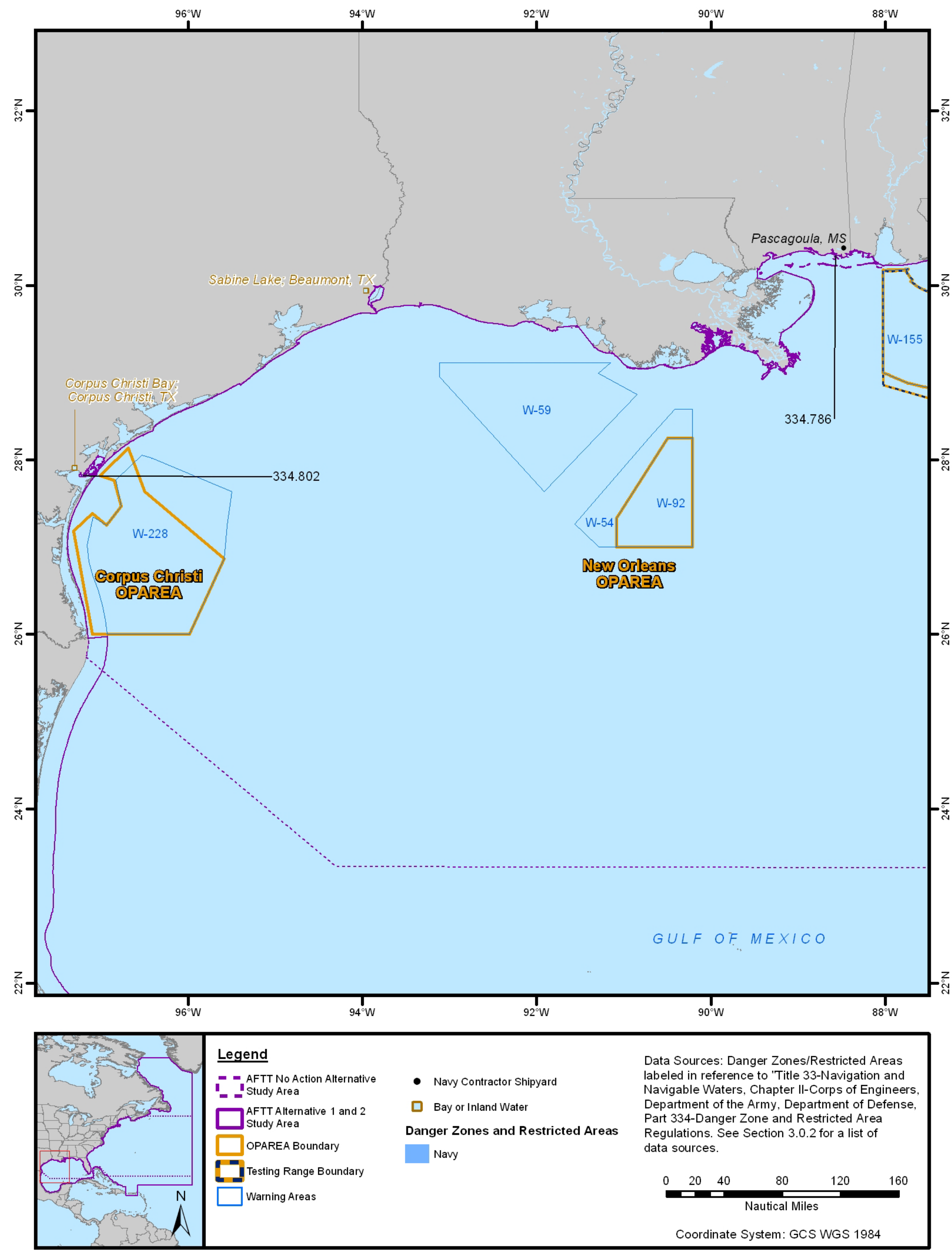

Figure 3.11-7: Danger Zones and Restricted Areas in the Gulf of Mexico

AFTT: Atlantic Fleet Training and Testing; MS: Mississippi; OPAREA: Operating Area; TX: Texas

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 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 the 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.

3.11.3.1.1 Socioeconomic Activities

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 of 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 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 1.5 to 4 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 1.5 to 4 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 result when Navy activities restrict access to fishing areas. 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 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, NMFS, 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

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. Further, the revenues listed in Tables 3.11-5 and 3.11-6 would not be impacted by restricted access because the restrictions are 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.

3.11.3.1.2 Evaluation of Alternatives

3.11.3.1.2.1 No Action Alternative

Training

Under the No Action Alternative, potential accessibility issues would be associated primarily with anti-air warfare, anti-surface warfare, anti-submarine warfare, mine warfare, amphibious warfare, and naval special warfare. Training activities in these warfare areas would continue at current levels and within established ranges and training locations, including the VACAPES, Navy Cherry Point, JAX, Key West, and GOMEX 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 1.5 to 4 hours per location). Based on the Navy's standard operating procedures and the large expanse of the training ranges, accessibility issues would be negligible.

Testing

Under the No Action Alternative, potential accessibility issues would be associated primarily with anti-air warfare, anti-surface warfare, anti-submarine warfare, mine warfare, amphibious warfare, naval special 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, VACAPES, Navy Cherry Point, JAX, Key West, and GOMEX Range Complexes; Naval Undersea Warfare Center Division, Newport Testing Range; CGULL OPAREA; Naval Surface Warfare Center, Panama City Division 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 1.5 to 4 hours per location). Based on the Navy's standard operating procedures and the large expanse of the training ranges, accessibility issues would be negligible.

3.11.3.1.2.2 Alternative 1

Alternative 1 consists of the activities in the No Action Alternative plus the expansion of the Study Area boundary and adjustments to locations and tempo of training and testing activities. Alternative 1 would include adjustments to the baseline and additional weapons, platforms, and systems. This alternative includes changes in force structure (personnel, weapons, and assets) requirements, new or upgraded weapons and platforms, and the training and testing required for proficiency with these systems. Alternative 1 includes the expansion of the Study Area boundary into the north Atlantic Ocean and part of the Gulf of Mexico, as shown on Figure 2.1-1.

Training

Under Alternative 1, potential accessibility issues would be the same as those associated with the No Action Alternative. Training activities in the same warfare areas would continue but with adjustments to locations and tempo of activities. There would be no changes to the Navy's standard operating procedures for public access to ocean and airspace. Similar to the No Action Alternative, there would be no anticipated impacts from Alternative 1 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 short duration (typically 1.5 to 4 hours per location). Based on the Navy's standard operating procedures and the expansion of the Study Area, accessibility issues would be minor.

Testing

Under Alternative 1, potential accessibility issues would be the same as those associated with the No Action Alternative. Testing would increase in tempo and adjustments to locations within the Study Area including testing activities that occurred at the South Florida Ocean Measurement Facility Testing Range. There would be no changes to the Navy's standard operating procedures for public access to testing ranges and other areas used for testing. Similar to the No Action Alternative, there would be no anticipated impacts from Alternative 1 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 1.5 to 4 hours per location). Based on the Navy's standard operating procedures and the expansion of the Study Area, accessibility issues would be minor.

3.11.3.1.2.3 Alternative 2 (Preferred Alternative)

Alternative 2 consists of the activities in the No Action Alternative, plus it establishes new range capabilities, modifies existing capabilities, and adjusts the type and tempo of training and testing. This alternative includes changes in force structure (personnel, weapons, and assets) requirements, new or upgraded weapons and platforms, and the training and testing required for proficiency with these systems. Alternative 2 includes the expansion of the Study Area boundary into the north Atlantic Ocean and part of the Gulf of Mexico, as shown on Figure 2.1-1.

Training

Under Alternative 2, potential accessibility issues would be the same as those associated with the No Action Alternative. Training activities in the same warfare areas would continue within the Study Area but with adjustments to locations and tempo of activities. There would be no changes to the Navy's standard operating procedures for public access to ocean and airspace. As in Alternative 1, 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 short duration (typically 1.5 to 4 hours per location). Based on the Navy's standard operating procedures and the expansion of the Study Area, accessibility issues would be minor.

Testing

Under Alternative 2, potential accessibility issues would be the same as those associated with the No Action Alternative. There would be no anticipated impacts from testing activities associated with Alternative 2 on energy production, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, aquaculture, or tourism. Accessibility issues associated with testing activities associated with Alternative 2 would be minor.

3.11.3.1.3 Conclusions

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 or employment, resource availability, or quality of experience.

3.11.3.2 Airborne Acoustics

As an environmental stressor, loud noises, sonic booms, and vibrations generated from Navy 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. Airborne noise would not impact energy generation, 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 3.9, Fish). Marine invertebrates (Section 3.8), also important commercial fishery resources, would not be affected by airborne acoustics because most species' ability to sense sound is very limited. Therefore, airborne noise from Navy activities would not impact commercial or recreational fishing.

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 nonparticipants, reducing the likelihood these activities would be heard. Tourism and recreational activity revenue (Tables 3.11-5 and 3.11-6) is not expected to be impacted by airborne noise. Most naval training would occur well out to sea, while civilian recreational activities are largely conducted within a few miles of shore, resulting in negligible impacts.

3.11.3.2.1 Evaluation of Alternatives

3.11.3.2.1.1 No Action Alternative

Training

Under the No Action Alternative, potential airborne noise issues would be associated primarily with anti-air warfare, anti-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, VACAPES, Navy Cherry Point, JAX, Key West, and GOMEX Range Complexes. There would be no anticipated impacts on energy production, 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 to ongoing activities in the training areas. Navy training activities producing airborne noise are normally short term and temporary. Therefore, airborne noise impacts on tourism and recreational activity would be negligible.

Testing

Under the No Action Alternative, potential airborne noise issues would be associated primarily with anti-air warfare, anti-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, VACAPES, Navy Cherry Point, JAX, Key West, and GOMEX Range Complexes; Naval Undersea Warfare Center Division, Newport Testing Range; CGULL OPAREA; and Naval Surface Warfare Center, Panama City Division Testing Range. There would be no anticipated impacts on energy production, 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 to ongoing activities in the testing areas. Navy testing activities producing airborne noise are normally short term and temporary. Therefore, airborne noise impacts on tourism and recreational activity would be negligible.

3.11.3.2.1.2 Alternative 1

Alternative 1 consists of the activities in the No Action Alternative plus the expansion of the Study Area boundary and adjustments to locations and tempo of training and testing activities. This alternative includes changes in force structure (personnel, weapons, and assets) requirements, new or upgraded weapons and platforms, and the training and testing required for proficiency with these systems. Alternative 1 includes the expansion of the Study Area boundary into the north Atlantic Ocean and part of the Gulf of Mexico, as shown on Figure 2.1-1.

Training

Under Alternative 1, the number of training activities associated with airborne noise would increase compared to the No Action Alternative. Training activities in the same warfare areas would continue but with adjustments to locations and tempo of activities. Similar to the No Action Alternative, there would be no anticipated impacts from Alternative 1 activities on energy production, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, and aquaculture. Navy training activities producing airborne noise are normally short term, temporary, and away from populated areas. Therefore, airborne noise impacts on tourism would be negligible.

Testing

Under Alternative 1, the number of testing activities associated with airborne noise would increase compared to the No Action Alternative. Testing within the Study Area would increase in tempo and change slightly in location. Testing activities for Alternative 1 would include up to four ship shock trials per year. Similar to the No Action Alternative, there would be no anticipated impacts from Alternative 1 testing activities on energy production, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, or aquaculture. Navy testing activities producing airborne noise are normally short term, temporary, and away from populated areas. Therefore, airborne noise impacts on tourism would be negligible.

3.11.3.2.1.3 Alternative 2 (Preferred Alternative)

Alternative 2 consists of the activities in the No Action Alternative plus adjustments to locations and tempo of training and testing activities. This alternative includes changes in force structure (personnel, weapons, and assets) requirements, new or upgraded weapons and platforms, and the training and testing required for proficiency with these systems. Alternative 2 includes the expansion of the Study Area boundary into the north Atlantic Ocean and part of the Gulf of Mexico, as shown on Figure 2.1-1.

Training

Under Alternative 2, the number of training activities associated with airborne noise would increase compared to the No Action Alternative. Training activities in the same warfare areas would continue but with adjustments to locations and tempo of activities. Similar to Alternative 1, there would be no anticipated impacts from Alternative 2 training activities on energy production, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, or aquaculture. Navy training activities producing airborne noise are normally short term, temporary, and away from populated areas. Therefore, airborne noise impacts on tourism would be negligible.

Testing

Under Alternative 2, the number of testing activities associated with airborne noise would increase compared to the No Action Alternative. Testing activities for Alternative 2 would include ship shock trials. Testing would increase in tempo and within the Study Area. Similar to Alternative 1, there would be no anticipated impacts from Alternative 2 testing activities on energy production, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, or aquaculture. Navy testing activities producing airborne noise are normally short term, temporary, and away from populated areas. Therefore, airborne noise impacts on tourism would be negligible.

3.11.3.2.2 Conclusions

Because the majority of Navy training and testing activity areas are not located where tourism and recreational activities occur, the impact of airborne noise is negligible. The public might intermittently hear noise from ships or aircraft overflights if they are in the general vicinity of training or testing, but these would be infrequent events. 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 Strikes

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 in-water 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 activities included in the Proposed Action involve vessel movement and use of towed devices. The likelihood that a Navy vessel would collide with a non-Navy vessel is remote because of the use of navigational aids by both Navy and civilians.

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 Socioeconomic Activities

3.11.3.3.1.1 <u>Sources of Energy Production and Distribution</u>

The evaluation of impacts on sources of energy generation 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. Military expended materials that damage equipment and infrastructure could disrupt energy production and distribution, which may impact industry revenue or operating costs. The Navy does not perform activities that would release military expended materials near known submerged equipment or infrastructure because these are known areas that are avoided by the Navy. The Navy does not perform activities that potentially would interfere with equipment or infrastructure. Therefore, Navy activities disrupting or disturbing equipment and structures in the water by physical strikes would be negligible.

3.11.3.3.1.2 <u>Mineral Extraction</u>

Similar to the potential impacts on sources of energy production, physical disturbances or strikes could damage or encounter equipment. Strikes that inadvertently snag, entangle, and damage sand and gravel extraction equipment or disrupt the sand and gravel extraction process may impact industry revenue or operating costs. The Navy has standard operating procedures for clearing training and testing areas before initiating hazardous activities. Navy expended materials would not impede offshore sand and gravel extraction because these activities are conducted using controlled suction processes (i.e., dragheads and submerged or floating pipelines). The Navy would avoid conducting training and testing in areas of mineral extraction. 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 <u>Commercial Transportation and Shipping</u>

There would be no anticipated impacts on commercial transportation activities in the Study Area since naval vessels and aircraft conducting training and testing generally conduct these activities away from commercially used waterways and airways. While physical disturbances or strikes could damage or encounter commercial marine vessels or aircraft, the Navy has standard operating procedures for clearing training and testing areas before initiating hazardous activities. The Navy's use of expended materials (i.e., objects moving through the water or air, dropped into the water, or resting on the ocean floor) during training and testing activities are conducted away from commercially used waterways and airways. 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

Any physical disturbance in the ocean or on the ocean floor, such as ship anchoring, targets or mines resting on the ocean floor, moored mines, bottom-mounted tripods, vessel movements, and use of towed system and attachment cables could inadvertently damage or destroy fisheries resources and associated habitat, as well as submerged fishing equipment and gear. Military expended materials, such as parachutes, cables, and guidance wires, can be deposited on the ocean bottom and could inadvertently snag, entangle, and damage fishing equipment. This could cause loss of income, revenue, and employment.

Section 3.9 (Fish) evaluated 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. Electromagnetic activities would not result in movement or behavioral responses, or in the destruction or adverse modification of critical habitats for fish in the Study Area. The use of towed devices may result in short-term and localized displacement of fishes in the water column or on the seafloor. There may be temporary movement of fish out of an area as a result of Navy training and testing activities; however, those relocations would not be permanent. Decreased populations of fish in the Study Area would not be expected and, therefore, loss of revenue or employment associated with commercial fishing would not occur. No change to recreational fishing in the Study Area would be anticipated.

Fishing activities have the potential to interact with equipment used during the proposed Navy training and testing operations. Commercial bottom-fishing activities, such as dredging, bottom trawling, long lines, and pots and traps, have the greatest potential for negative impacts. Interaction with bottom-fishing gear could result in the loss of or damage to both commercial and naval hardware and fishing gear. These bottom fishing commercial gear account for most fishing gear types used in the Study Area (Tables 3.11-1 through 3.11-3). Entanglement by cables and guidance wires expended during training activities would not result in destruction or adverse modification of fish habitat. Based on the large size of the Study Area, the limited areas of activities, and the advance public release of Notices to Mariners, impacts on commercial or recreational fishing in the Study Area would be unlikely.

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, targets or mines resting on the ocean floor, moored mines, bottom-mounted tripods, vessel movements, and use of towed systems and attachment cables could inadvertently damage or destroy aquaculture gear; however, aquaculture activities have specific depth requirements that would not coincide with activities that would have an impact.

3.11.3.3.1.6 Tourism

Navy training and testing involving non-explosive practice munitions, aircraft, ship movement, towed in-water devices, and ocean bottom-deployed devices occur in the Study Area. Most naval training and testing would occur well out to sea, while many popular civilian recreational activities are conducted within a few miles of land. 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. Changes to tourism activities in the Study Area would not be expected and, therefore, loss of revenue or employment associated with tourism would not occur.

Other tourism activities such as whale watching, boating, or use of other watercraft occur farther out to sea and are conducted by boat, by aircraft, or from land. These activities would be conducted with 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 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. At the same time, Navy vessels ensure that an area is clear of nonparticipants before training and testing exercises. As a result, conflicts between Navy training and testing activities in offshore areas and whale watching or other offshore recreational use would not occur. 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 occur.

The Navy would continue to recover many of the targets used in training and testing so they would not pose a collision risk. Unrecoverable pieces are typically small, 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 represent a collision risk to recreational vessels.

3.11.3.3.2 Evaluation of Alternatives

3.11.3.3.2.1 No Action Alternative

Training

Under the No Action Alternative, potential physical disturbance and strike issues would be associated primarily with anti-air warfare, anti-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, VACAPES, Navy Cherry Point, JAX, Key West, and GOMEX Range Complexes. There would be no anticipated impacts on energy production, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, aquaculture, or tourism because the Navy clears the area before training activities take place and the Navy does not train in areas close to infrastructure or civilian activities. Based on the Navy's standard operating procedures and the large expanse of the training ranges, the likelihood of a physical disturbance or strike on civilian property (i.e., equipment or vessels) in the Study Area would be negligible. Therefore, loss of revenue or employment changes to human activities in the Study Area would not be expected.

Testing

Under the No Action Alternative, potential physical disturbance and strike issues would be associated primarily with anti-air warfare, anti-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, VACAPES, Navy Cherry Point, JAX, Key West, and GOMEX Range Complexes; Naval Undersea Warfare Center Division, Newport Testing Range; CGULL OPAREA; 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 clears the area before testing activities take place and the Navy does not test in areas close to infrastructure or civilian activities. Based on the Navy's standard operating procedures and the large expanse of the Study Area, the likelihood of a physical disturbance or strike on civilian property would be negligible.

3.11.3.3.2.2 Alternative 1

Alternative 1 consists of the activities in the No Action Alternative plus the expansion of the Study Area boundary and adjustments to locations and tempo of training and testing activities. This alternative includes changes in force structure (personnel, weapons, and assets) requirements, new or upgraded weapons and platforms, and the training and testing required for proficiency with these systems. Alternative 1 includes the expansion of the Study Area boundary into the north Atlantic Ocean and part of the Gulf of Mexico, as shown on Figure 2.1-1.

Training

Under Alternative 1, potential physical disturbance and strike issues would be the same as those associated with the No Action Alternative. Training activities in the same warfare areas would continue within the Study Area but with adjustments to locations and tempo of activities. There would be no changes to the Navy's standard operating procedures for training activities performed in the Study Area. Similar to the No Action Alternative, there would be no anticipated impacts from Alternative 1 training activities on energy production, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, aquaculture, or tourism because the Navy clears the area before training activities take place and the Navy does not train in areas close to infrastructure or civilian activities. Based on the Navy's standard operating procedures and the size of the Study Area, the likelihood of a physical disturbance or strike on civilian property would be negligible.

Testing

Under Alternative 1, potential physical disturbance and strike issues would be the same as those associated with the No Action Alternative with the addition of ship shock trials. Testing within the Study Area would increase in tempo and testing locations may vary. There would be no changes to the Navy's standard operating procedures for public access to testing ranges. Similar to the No Action Alternative, there would be no anticipated impacts from Alternative 1 testing activities on energy production, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, aquaculture, or tourism because the Navy clears the area before testing activities take place and the Navy does not test in areas close to infrastructure or civilian activities. Based on the Navy's standard operating procedures and the size of the Study Area, the likelihood of a physical disturbance or strike on civilian property would be negligible.

3.11.3.3.2.3 Alternative 2 (Preferred Alternative)

Alternative 2 consists of the activities in the No Action Alternative plus adjustments to locations and tempo. This alternative includes changes in force structure (personnel, weapons, and assets) requirements, new or upgraded weapons and platforms, and the training and testing required for proficiency with these systems. Alternative 2 includes the expansion of the Study Area boundary into the north Atlantic Ocean and part of the Gulf of Mexico, as shown on Figure 2.1-1.

Training

Under Alternative 2, potential physical disturbance and strike issues would be the same as those associated with the No Action Alternative. Training activities in the same warfare areas would continue but with adjustments to locations and tempo of activities. There would be no changes to the Navy's standard operating procedures for public access to ocean and airspace. As in Alternative 1, 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, and tourism because the Navy clears the area before training activities take place and the Navy does not train in areas close to infrastructure or civilian activities. Based on the Navy's standard operating procedures and the size of the Study Area, the likelihood of a physical disturbance or strike on civilian property would be negligible.

Testing

Under Alternative 2, potential physical disturbance and strike issues would be the same as those associated with the No Action Alternative with the addition of ship shock trials. Testing within the Study Area would increase in tempo and testing locations may vary. There would be no changes to the Navy's standard operating procedures for public access to test ranges. As in Alternative 1, 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 the Navy clears the area before testing activities take place and the Navy does not test in areas close to infrastructure or civilian activities. Based on the Navy's standard operating procedures and the size of the Study Area, the likelihood of a physical disturbance or strike on civilian property would be negligible.

3.11.3.3.3 Conclusions

Because the Navy clears areas before performing training and testing activities and the Navy does not train in areas close to infrastructure or civilian activities, physical disturbances and strikes are unlikely. Therefore, the activities would not result in a direct loss of income, revenue or employment, resource availability, or quality of experience.

3.11.4 Summary of Potential Impacts

3.11.4.1 Analysis of Secondary Stressors

Socioeconomics could be impacted if the proposed activities led to changes to physical and biological resources to the extent that they would alter the way industries can use those resources. Any potential impact on sediment and water quality, or on air quality, was considered to be a secondary stressor to socioeconomic resources. Secondary stressors may affect resource availability of minerals (e.g., offshore extraction of sand) and fisheries within the Study Area.

Mineral extraction activities could be impacted if the proposed 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 continue. Because of the large size of the Study Area and the availability of offshore mineral resources, loss of revenue would not be expected. As discussed in Section 3.1 (Sediments and Water Quality), military expended materials would not impact sediment quality and availability or cost of extracting mineral resources. Therefore, there would be no indirect impacts associated with the Proposed Action on mineral extraction.

Fishing, aquaculture, and tourism could be impacted if the Proposed Action altered fish population levels to such an extent that these socioeconomic activities could no longer find sufficient abundance of targeted species. Sections 3.4 (Marine Mammals), 3.8 (Invertebrates), and 3.9 (Fish) determined, however, that there would be no population level impacts on marine species from training and testing activities. For these reasons, there would be no indirect impacts on commercial or recreational fishing, aquaculture, or tourism.

3.11.4.2 Combined Impacts of All Stressors

Stressors described in this EIS/OEIS that have potential impacts on socioeconomic resources include accessibility to air and sea space within the Study Area, airborne acoustics, physical disturbances and strikes, and indirect impacts from availability of resources (e.g., mineral resources and fisheries). Under the No Action Alternative, Alternative 1, or Alternative 2, these activities would be widely dispersed throughout the Study Area. Such activities also are dispersed temporally (i.e., few stressors would operate at the same time). Therefore, no greater impacts from the combined operation of more than one stressor are expected. The aggregate effect on socioeconomic resources would not observably differ from existing conditions.

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3.12 PUBLIC HEALTH AND SAFETY

PUBLIC HEALTH AND SAFETY SYNOPSIS

The Navy considered all potential stressors and the following have been analyzed for public health and safety:

- Underwater energy
- In-air energy
- Physical interactions
- Indirect impacts from sediment and water quality changes

Alternative 2 (Preferred Alternative)

Because of the Navy's standard operating procedures, impacts to public health and safety would be unlikely.

3.12.1 INTRODUCTION AND METHODS

3.12.1.1 Introduction

This section analyzes potential impacts on public health and safety within the Atlantic Fleet Training and Testing (AFTT) Study Area (Study Area). Unlike military training and testing activities conducted within a fenced-in boundary of an installation on land, public access to areas at sea or overlying airspace cannot be physically controlled. The Navy coordinates use of these areas internally by scheduling activities and by issuing warnings and notices to the public before conducting potentially hazardous activities (Section 3.12.2.2, Safety and Inspection Procedures). Areas of heightened sensitivity to public health and safety concerns within the Study Area include areas where the public may be close to certain activities (e.g., pierside sound navigation and ranging [sonar testing] or littoral training).

Generally, the greatest potential for a proposed activity to affect the public is in coastal areas because of the concentration of public activities. These coastal areas could be close to dive sites and other recreational areas where the collective health and safety of groups of individuals who could be exposed to the hazards associated with training and testing would be of concern. Most commercial and recreational marine activities (with the exception of commercial shipping) are close to the shore, usually limited by the capabilities of the boat used. Commercial and recreational fishing activities may extend as far out as 100 nautical miles (nm) from shore, but many are closer to the shoreline.

3.12.1.2 Methods

The baseline for public health and safety was 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 that describe criteria for public health and safety considerations. The baseline for public health and safety was derived from training and testing activities under the No Action Alternative and under the Study Area shown in Figure 2.6-1.

The alternatives were evaluated based on two factors: the potential that a training or testing activity could impact public health and safety and the degree to which those activities could have an impact. The likelihood that the public would be near a training or testing activity determines the potential for exposure to the activity. If the potential for exposure exists, 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 does not exist, there would be no impacts on public health and safety. Isolated incidents and other conditions that affect single individuals, although important for safety awareness, are not considered in this assessment (e.g., airborne noise effects are not addressed in this section).

3.12.2 Affected Environment

3.12.2.1 Overview

The area of interest for assessing potential impacts on public health and safety is the United States (U.S.) territorial waters of the east and gulf coasts (seaward of the mean high water line to 12 nm). Military, commercial, institutional, and recreational activities take place simultaneously in the Study Area (Figure 3.12-1) and have coexisted safely for decades. These activities coexist because there are rules and practices that lead to safe use of the waterway or airspace. The following paragraphs briefly discuss the rules and practices for recreational, commercial, and military use in sea surface areas and airspace.

Figure 3.12-1: Simultaneous Activities within the Study Area

3.12.2.1.1 Sea Space

Most of the sea space in the Study Area is accessible to recreational and commercial activities; however, some activities are prohibited or restricted in certain areas. 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 Code of Federal Regulations (C.F.R.) Part 72, the U.S. Coast Guard and the Department of Homeland Security publish marine information pertaining to sea space (e.g., danger zones and restricted areas, Figures 3.11-4 through 3.11-7 in Section 3.11, Socioeconomic Resources). Notices to Mariners provide information to private and commercial vessels regarding temporary closures of areas. 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 hazardous to surface vessels. Civilian vessel operators 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.

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 that refers to 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 2011). 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 ordnance). Some areas are under strict control of the DoD, and some are shared with nonmilitary agencies.
- Military Operations Area: Areas typically below 18,000 feet (ft.) used to separate 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 nonparticipating aircraft of potential danger.
- Air Traffic Controlled Assigned Airspace: Airspace that is Federal Aviation Administration-defined and is not over an existing operating area. This airspace is used to contain specified activities, such as military flight training, that are segregated from other instrument flight rules air traffic.

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. 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 will 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 represent 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

During training and testing, it is Navy policy to ensure the safety and health of personnel and the general public (U.S. Department of the Navy 2011c). The Navy achieves these conditions by considering a location when planning activities, scheduling and notifying potential users of an area, and making sure an area is clear of nonparticipants. The Navy also has a proactive and comprehensive program of compliance with applicable standards and implementation of safety management systems.

As previously stated, the greatest potential for a training or testing activity to affect the public is in coastal areas because of the concentration of public activities. When planning a training or testing event, 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 or events; and safety history.

The Navy's Fleet Area Control and Surveillance Facilities provide active management of assigned airspace, operating areas, ranges, and training and testing resources to enhance combat readiness of U.S. Fleet Forces Command units. The Navy schedules activities through the Fleet Area Control and Surveillance Facilities who will coordinate air and surface use of the operating areas (OPAREAs) with the Federal Aviation Administration and the U.S. Coast Guard, which will 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 nonparticipants before engaging in certain activities such as weapon firing. Inability to obtain a "clear range" could result in the delay, cancelation, or relocation of an event. This approach ensures public safety during Navy activities that otherwise could harm nonparticipants. 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 comply with the Fleet Area Control and Surveillance Facility procedures. Fleet Area Control and Surveillance Facilities Virginia Capes (VACAPES) and Jacksonville (JAX) have published safety procedures for activities on the offshore and nearshore areas (U.S. Department of the Navy 2011a, b). 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 underwater ordnance must be coordinated with submarine operational authorities. The coordination also applies to towed sonar arrays and torpedo decoys.
- Aircraft or vessels expending ordnance shall not commence firing without 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 ordnance 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 nonparticipants.

Testing activities have their own comprehensive safety planning instructions (U.S. Department of the Navy 2008b, 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.

The following safety and inspection procedures are implemented, and the commanding officer is responsible for implementing safety and inspection procedures, for activities conducted inside and outside testing or training ranges. In the absence of specific guidance on matters of safety, the Navy follows the most prudent course of action. The following subsections contain information on the Navy's program of compliance with applicable standards and implementation of safety management systems.

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 3770.2K, *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 Facilities VACAPES and JAX (U.S. Department of the Navy 2011b). Testing ranges have their own procedures for aviation safety, like the Naval Surface Warfare Center, Panama City Division Instruction (U.S. Department of the Navy 2008b) and Naval Undersea Warfare Center Division, Newport Instruction (U.S. Department of Defense 2009).

Aircrews involved in a training or testing exercise must be aware that nonparticipating 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 nonparticipating aircraft while operating in warning areas under visual flight rules. In general, aircraft carrying ordnance are not allowed to fly over surface vessels.

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. When transiting submerged, submarines use all available ocean navigation tools, including inertial navigation charts that calculate position based on the submerged movements of the submarine. Areas with surface vessels can then be avoided to protect both the submarines and surface vessels.

3.12.2.2.3 Surface Vessel Navigation Safety

The Navy practices the fundamentals of safe navigation. While in transit, Navy surface vessel operators are alert at all times, use extreme caution, use state-of-the-art satellite navigational systems, and are trained to take proper action if there is potential risk. Surface vessels are also equipped with trained and qualified Navy lookouts. Individuals trained as lookouts have the necessary skills to detect objects or activity in the water that could potentially be a risk for the vessel.

For specific testing activities, like unmanned surface vehicle testing, a support boat will be used in the vicinity of the testing to ensure safe navigation. Before firing or launching a weapon or radiating a non-eyesafe laser, Navy surface vessels are required to determine that all safety criteria have been satisfied. When applicable, the surface vessel will use aircraft and other boats to aid in navigation. In accordance with Navy instructions presented in this chapter, safety and inspection procedures ensure public health and safety.

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 the training or testing exercise location. 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).

Naval Sea Systems Command Instruction 3150.2, Appendix 1A, *Safe Diving Distances from Transmitting Sonar*, is the Navy's governing document for protection of divers during active sonar use (U.S. Department of the Navy 1999). This instruction 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. Some safety procedures include measurements to be taken during testing activities to identify an exclusion area for nonparticipating swimmers and divers.

3.12.2.2.5 Electromagnetic Energy Safety

All frequencies (or wavelengths) of electromagnetic energy are referred to as the electromagnetic spectrum and include electromagnetic radiation 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, ordnance, 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, ordnance, and fuels (U.S. Department of Defense 2009). Thresholds for determining hazardous levels of electromagnetic energy to humans, ordnance, and fuel have been determined for electromagnetic energy sources based on frequency and power output, and current 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 nonparticipants in operational areas before conducting training

(U.S. Department of the Navy 2011a, b) and testing (U.S. Department of the Navy 2008b, 2009) activities that involve underwater electromagnetic energy (e.g., mine warfare).

Mine warfare devices are analyzed under other resources in this Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) because they emit electromagnetic energy. The electromagnetic effects from mine warfare devices are extremely localized, unlike radars and radios. Measures to avoid public interaction with mine warfare devices are effective at protecting the public from these effects.

3.12.2.2.6 Laser Safety

Lasers produce light energy. The Navy uses tactical lasers for precision range finding, as target designation/illumination devices for engagement with laser-guided weapons, and for mine detection and mine countermeasures. Testing activities would also include high energy laser weapons tests to evaluate the specifications, integration, and performance of an aircraft-mounted, high energy laser. The high energy laser would be used as a weapon to disable small surface vessels. Laser safety procedures for aircraft require an initial pass over the target before laser activation to ensure that target areas are clear. The Navy observes strict precautions and has written instructions in place for laser users to ensure that nonparticipants are not exposed to intense light energy. During actual laser use, aircraft run-in headings are restricted to avoid unintentional contact with personnel or nonparticipants. Personnel participating in laser training activities are required to complete a laser safety course (U.S. Department of the Navy 2008a).

3.12.2.2.7 High-Explosive Ordnance Detonation Safety

Pressure waves from underwater detonations can pose a physical hazard in surrounding waters. Before conducting an underwater training or testing activity, Navy personnel establish an appropriately sized exclusion zone to avoid exposure of nonparticipants to the harmful intensities of pressure. Naval Sea Systems Command Instruction 3150.2, Chapter 2, *Safe Diving Distances from Transmitting Sonar*, provides procedures for determining safe distances from underwater explosions (U.S. Department of the Navy 1999). In accordance with training and testing procedures for safety planning related to detonations (Section 3.12.2.2.8, Weapons Firing and Ordnance Expenditure Safety), the Navy uses the following general and underwater detonation procedures:

- Navy personnel are responsible for ensuring that impact areas and targets are clear before commencing hazardous activities.
- The use of underwater ordnance must be coordinated with submarine operational authorities.
- Aircraft or vessels expending ordnance 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 will be conducted during daylight hours.

3.12.2.2.8 Weapons Firing and Ordnance Expenditure Safety

In accordance with safety and inspection procedures (U.S. Department of the Navy 2011b), any unit conducting firing and ordnance expenditure shall ensure that all possible safety precautions are taken to prevent accidental injury or property damage. The Officer Conducting the Exercise shall permit firing or jettisoning of aerial targets only when the area is confirmed to be clear of nonparticipating units, both civilian and military.

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 ordnance, they are required to make a preliminary pass over the intended target area to ensure that it is clear of boats, divers, or other nonparticipants. Aircraft carrying ordnance are not allowed to fly over surface vessels.

Training and testing activities are delayed, moved, or cancelled if there is any question about the safety of the public. Target areas must be clear of nonparticipants before conducting training and testing. When using ordnance 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 nonparticipants 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) potentially impact public health and safety. Table 2.8-1 through 2.8-3 present the baseline and proposed training and testing activity locations for each alternative (including the number of events and ordnance expended). Each public health and safety stressor is introduced, analyzed by alternative, and analyzed for training and testing activities. Table F-1 in Appendix F shows 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:

- underwater energy
- in-air energy
- physical interactions

Alternatives 1 and 2 include the expansion of the Study Area boundary to the north Atlantic Ocean, the southern part of the Gulf of Mexico, and in shipyards. While Alternatives 1 and 2 would adjust locations and tempo of training and testing activities, existing safety procedures and standard operating procedures would be employed such that no new or additional impacts to public health and safety would occur. Therefore, the expansion of the Study Area boundary will not be addressed in the analysis below.

The potential for impacts on public health and safety were evaluated assuming the continued implementation of the Navy's current safety procedures for each training and testing activity or group of similar activities. Generally, the greatest potential for the proposed activities to be co-located with public activities would be in coastal areas because most commercial and recreational activities occur close to the shore.

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 2011a, b) and Test and Safety Planning Instructions (U.S. Department of the Navy 2008b, 2009). These instructions provide operational and safety procedures for all normal range events. They also provide information to range users that is necessary to operate safely and avoid affecting nonmilitary 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. Current requirements and practices (e.g., standard operating procedures) designed to prevent public health and safety impacts are identified in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring).

3.12.3.1 Underwater Energy

Underwater energy can come from acoustic sources or electromagnetic devices. Active sonar, underwater explosions, airguns, and vessel movements produce underwater acoustic energy. Sound will travel from air to water during aircraft overflights. Electromagnetic energy can enter the water from mine warfare training devices and unmanned underwater systems. The potential for the public to be exposed to these stressors would be limited to individuals, such as recreational swimmers or self-contained underwater breathing apparatus (SCUBA) divers, that are underwater and within unsafe proximity of a training or testing event.

Underwater acoustic energy is generated from many of the proposed activities; however, not all rise to the level of consideration in this EIS/OEIS. 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 duration of events. Pierside integrated swimmer defense testing with underwater airguns is conducted during swimmer defense and diver deterrent training and testing activities; public health and safety would be ensured for these localized activities because access to pierside locations by nonparticipants is controlled for safety and security reasons. Because of the infrequency and short duration of the events, underwater acoustic energy from vessel movements, aircraft overflights, and airguns is not analyzed in further detail. Active sonar and underwater explosions are the only sources of underwater acoustic energy evaluated for potential impacts on public health and safety.

The proposed activities that would result in underwater acoustic energy include activities such as amphibious warfare, anti-surface warfare, anti-submarine warfare, mine warfare, civilian port defense, surface warfare testing, littoral combat ship testing, sonar maintenance, pierside sonar testing, and unmanned 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. Underwater explosives cause a physical shock front that compresses the explosive material, and the pressure wave then passes into the surrounding water. Generally, the pressure wave would be the primary cause of injury. The effects of an underwater 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 like the Organic Airborne and Surface Influence Sweep, which emit an electromagnetic field and sound to simulate the presence of a ship. It can also be used to cause nearby mines to explode. Unmanned underwater vehicles, some unmanned surface vehicles, and towed devices use electromagnetic energy. Electronic warfare activities involve aircraft, surface ship, and submarine crews attempting to control portions of the electromagnetic spectrum to degrade or deny the enemy’s ability to take defensive actions. Electromagnetic signals dissipate quickly with distance from the source. There is a lack of evidence in the literature to infer any 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. Because standard operating procedures require an area to be clear of participants, platforms emitting higher energy levels are not operated within 15 nm of shore and the public would not be exposed to electromagnetic energy the way a worker could experience long-term, occupational exposures. In the unlikely event that an exposure did occur, the level of electromagnetic energy associated with the Proposed Action would not be enough to pose a health and safety risk to the public. Therefore, the use of electromagnetic devices was eliminated as a potential underwater energy stressor on public health and safety.

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 certified open-water divers limit their dives to 60 ft. (18 meters [m]). More experienced divers are generally limited to 100 ft. (30.5 m); in general, no recreational diver should exceed 130 ft. (40 m) (Professional Association of Diving Instructors 2011). These depths typically limit this activity's distance from shore. Therefore, training and testing activities closest to shore have the greatest potential to co-occur with the public.

Swimmers and recreational SCUBA divers are not expected to be near Navy pierside locations (which include shipyards) because access to these areas is controlled for safety and security reasons. 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. Therefore, co-occurrence of recreational divers and Navy activities is unlikely. Swimmers and recreational divers are not expected to be near training and testing locations where active sonar, underwater explosions, and electromagnetic activities would occur because of the strict procedures for clearance of nonparticipants before conducting activities.

The U.S. Navy Dive Manual (U.S. Department of the Navy 1999) prescribes safe distances from active sonar sources and underwater explosions. Safety precautions regarding use of electromagnetic energy are specified in DoD Instruction 6055.11, *Protecting Personnel from Electromagnetic Fields* (U.S. Department of Defense 2002, 2009) and Military Standard 464A, *Electromagnetic Environmental Effects: Requirements for Systems* (U.S. Department of Defense 2002). These distances would be used as the standard safety buffers for underwater energy to protect public health and safety. If any unauthorized personnel are detected within the exercise area, the activity would be temporarily halted until the area is again cleared and secured.

3.12.3.1.1 No Action Alternative

3.12.3.1.1.1 Training

Under the No Action Alternative, active sonar training activities such as anti-submarine warfare, mine warfare, and sonar maintenance would continue at current levels and at current locations including the Northeast, VACAPES, Navy Cherry Point, JAX, and Gulf of Mexico (GOMEX) Range Complexes. Activities involving underwater explosions, such as anti-surface warfare and mine warfare, would also continue at current levels and at current locations. Current locations for underwater explosions include specific training areas in VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes, and the Sinking Exercise Boxes outside of the range complexes.

The analysis indicates that there would be no impact on public health and safety from training activities using underwater energy, based on the Navy's implementation of strict operating procedures that protect public health and safety. These operating procedures include ensuring clearance of the area before commencing training activities involving underwater energy. Because of the Navy's safety procedures, the potential for training activities using underwater energy to impact public health and safety under the No Action Alternative would be unlikely.

3.12.3.1.1.2 Testing

Under the No Action Alternative, active sonar testing activities such as anti-submarine warfare, mine warfare, pierside sonar testing, unmanned vehicle testing, and sonar maintenance would continue at current levels and in current locations, including areas such as the Naval Undersea Warfare Center Division, Newport Testing Range; Narragansett Bay; CGULL OPAREA; Naval Surface Warfare Center, Panama City Division Testing Range; and the VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes. Pierside testing of active sonar would continue to occur in Little Creek, Virginia; King's Bay, Georgia; and Port Canaveral, Florida. Testing activities involving underwater explosions, such as anti-air warfare, anti-surface warfare, anti-submarine warfare, mine warfare, and surface combatant sea trials would also continue at current levels and at current locations. Current locations for underwater explosions include specific training areas in VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes; Naval Surface Warfare Center, Panama City Division Testing Range; and the CGULL OPAREA.

The analysis indicates that there would be no impact on public health and safety from testing activities using underwater energy, based on the Navy's implementation of strict operating procedures that protect public health and safety. These operating procedures include ensuring clearance of the area before commencing testing activities involving underwater energy. Because of the Navy's safety procedures, the potential for testing activities to impact public health and safety under the No Action Alternative would be unlikely.

3.12.3.1.2 Alternative 1

Alternative 1 consists of the activities in the No Action Alternative plus adjustments to locations and tempo of training and testing activities. This alternative includes changes in force structure (personnel, weapons, and assets) requirements, new or upgraded weapons and platforms, and the training and testing required for proficiency with these systems.

3.12.3.1.2.1 Training

Active sonar training events would continue to occur at current locations under Alternative 1; however, in many circumstances, the potential areas for these activities are expanded (see tables in Chapter 2). Locations for active sonar training include the Northeast, VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes and Other AFTT Areas. While Alternative 1 would adjust locations and tempo of active sonar training activities, the Navy would continue implementation of standard operating and safety procedures; therefore, an increased potential for impacts on public health and safety beyond those identified under the No Action Alternative would be unlikely.

Activities involving underwater explosions, such as anti-surface warfare, mine warfare, and civilian port defense, would also continue at current locations. The proposed locations include the VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes, and the Sinking Exercise Boxes outside the range complexes. While Alternative 1 would adjust locations and tempo of underwater explosions training activities, the Navy would continue implementation of standard operating and safety procedures;

therefore, an increased potential for impacts on public health and safety beyond those identified under the No Action Alternative would be unlikely.

Because of the Navy's safety procedures, the potential for training activities to impact public health and safety under Alternative 1 would be unlikely.

3.12.3.1.2.2 Testing

Locations and tempo of active sonar testing activities would increase over the No Action Alternative. Alternative 1 also includes changes in force structure (personnel, weapons, and assets) requirements, new or upgraded weapons and platforms, and the testing required for these systems.

Under Alternative 1, there would be an increase in active sonar testing activities such as anti-submarine warfare, mine warfare, pierside sonar testing, unmanned vehicle testing, sonar maintenance, and sonobuoy lot acceptance testing. These activities would continue to occur in areas such as Narragansett Bay; South Florida Ocean Measurement Facility Testing Range; Naval Surface Warfare Center, Panama City Division Testing Range; Key West OPAREA; and the Northeast, VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes. Pierside testing of active sonar would continue to occur in Little Creek, Virginia; King's Bay, Georgia; and Port Canaveral, Florida; however, additional testing would occur pierside in places like Bath, Maine; Groton, Connecticut; Norfolk and Newport News, Virginia; and Pascagoula, Mississippi. While Alternative 1 would adjust locations and tempo of active sonar testing activities, the Navy would continue implementation of standard operating and safety procedures; therefore, an increased potential for impacts on public health and safety beyond those identified under the No Action Alternative would be unlikely.

Testing activities involving underwater explosions—such as anti-air warfare, anti-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—would occur in the Key West OPAREA; Northeast, VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes; Naval Surface Warfare Center, Panama City Division Testing Range; and the South Florida Ocean Measurement Facility Testing Range. While Alternative 1 would adjust locations and tempo of testing activities involving underwater explosions, the Navy would continue implementation of standard operating and safety procedures; therefore, an increased potential for impacts on public health and safety beyond those identified under the No Action Alternative would be unlikely.

Because of the Navy's safety procedures, the potential for testing activities to impact public health and safety under the Alternative 1 would be unlikely.

3.12.3.1.3 Alternative 2 (Preferred Alternative)

Alternative 2 consists of the activities in the No Action Alternative plus adjustments to locations and tempo of training and testing activities. This alternative includes changes in force structure (personnel, weapons, and assets) requirements, new or upgraded weapons and platforms, and the training and testing required for proficiency with these systems.

3.12.3.1.3.1 Training

Alternative 2 is identical to Alternative 1 in the increase in active sonar and underwater explosions over the No Action Alternative. Alternative 2 is also identical to Alternative 1 in the proposed locations for these activities. As concluded under Alternative 1, an increased potential for impacts on public health and safety beyond those identified under the No Action Alternative would be unlikely. Because of the

Navy's safety procedures, the potential for underwater training activities to impact public health and safety under Alternative 2 would be unlikely.

3.12.3.1.3.2 Testing

Alternative 2 would adjust locations and tempo of testing activities of active sonar and underwater explosions over the No Action Alternative. Similar to the analysis under Alternative 1, an increased potential for impacts on public health and safety beyond those identified under the No Action Alternative would be unlikely. Because of the Navy's safety procedures, the potential for underwater testing activities to impact public health and safety under Alternative 2 would be unlikely.

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, navigational aids, and electronic warfare systems. These systems operate similarly to other navigational aids and radars at local airports and television weather stations throughout the United States. Electronic warfare systems emit electromagnetic energy similar to that from cell phones, hand-held radios, commercial radio stations, and television stations. Current practices are in place 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. Procedures also are in place to limit public and participant exposure from electromagnetic energy emitted by military aircraft.

As described in Section 3.0.5.3.2.2 (Lasers), two types of lasers are used under the Proposed Action. Low energy lasers are used to illuminate or designate targets, to guide weapons, and to detect or classify mines. 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 Operational Naval Instruction 5100.23G, *Navy Safety and Occupational Health Program Manual* (U.S. Department of the Navy 2011c). These high energy light sources can cause eye injuries. A comprehensive safety program exists for the use of lasers. Current Navy practices protect individuals from the hazard of severe eye injury caused by laser energy. Laser safety requirements for aircraft require verification that target areas are clear before commencement of the exercise. In addition, 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 anti-surface warfare, mine warfare, and civil port defense; there are no training activities that use high energy lasers. Testing activities involving low energy lasers include surface warfare; air operations at Naval Surface Warfare Center, Panama City Division Testing Range; and mine warfare testing. High energy laser weapon testing activities are the only testing activities using high energy laser weapons and will occur only in the VACAPES Range Complex.

3.12.3.2.1 No Action Alternative

3.12.3.2.1.1 Training

Under the No Action Alternative, electronic warfare training activities involving electromagnetic energy sources would continue at current levels and in current locations, including the VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes. Laser targeting activities and mine detection activities using lasers would also continue at current levels within the VACAPES, Navy Cherry Point, and JAX Range Complexes.

It is unlikely that the public would be exposed to electromagnetic energy sources or lasers under the No Action Alternative. Based on the Navy's strict safety procedures for use of lasers and electronic warfare, it is unlikely these activities would be conducted close enough to the public to pose an increased risk. Because of the Navy's safety procedures, the potential for these training activities to impact public health and safety under the No Action Alternative would be unlikely.

3.12.3.2.1.2 Testing

Under the No Action Alternative, electronic warfare testing activities involving electromagnetic energy sources would continue at current levels and in current locations, including the specific areas of the VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes and the Naval Surface Warfare Center Panama City Division Testing Range. Laser targeting activities and mine detection activities using lasers would continue at current levels and within current ranges and locations, including the VACAPES and JAX Range Complexes and the Naval Surface Warfare Center, Panama City Division Testing Range. No high energy lasers would be used under this alternative.

It is unlikely that the public would be exposed to electromagnetic energy sources or lasers from testing activities under the No Action Alternative. Because of the Navy's strict safety procedures for use of lasers and electronic warfare, it is unlikely these activities would be conducted close enough to the public to pose an increased risk, and the potential for these testing activities to impact public health and safety under the No Action Alternative would be unlikely.

3.12.3.2.2 Alternative 1

Alternative 1 consists of the activities in the No Action Alternative plus adjustments to locations and tempo of training and testing activities. This alternative includes changes in force structure (personnel, weapons, and assets) requirements, new or upgraded weapons and platforms, and the training and testing required for proficiency with these systems.

3.12.3.2.2.1 Training

Under Alternative 1, the number of training activities that use electromagnetic energy would increase and would occur within the VACAPES, Navy Cherry Point, JAX, Key West, and GOMEX Range Complexes. Laser targeting activities and mine detection activities using lasers would increase within the VACAPES, Navy Cherry Point, and JAX Range Complexes.

While Alternative 1 would adjust locations and tempo of training activities involving electromagnetic energy and lasers, the Navy would continue implementation of standard operating and safety procedures; therefore, an increased potential for impacts on public health and safety beyond those identified under the No Action Alternative would be unlikely.

3.12.3.2.2.2 Testing

Under Alternative 1, the number of testing activities that use electromagnetic energy would increase and would occur in the VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes. Laser targeting activities and mine detection activities using lasers would increase and would occur in the VACAPES and JAX Range Complexes. High energy laser equipment has undergone Navy review and approval and is designed to incorporate safety precautions and engineering controls to prevent mishaps. Alternative 1 also includes the use of high energy lasers in the VACAPES Range Complex as an adjustment to baseline activities.

While Alternative 1 would adjust locations and tempo of testing activities involving electromagnetic energy and lasers, the Navy would continue implementation of standard operating and safety procedures; therefore, an increased potential for impacts on public health and safety beyond those identified under the No Action Alternative would be unlikely.

3.12.3.2.3 Alternative 2 (Preferred Alternative)

Alternative 2 consists of the activities in the No Action Alternative plus adjustments to locations and tempo of training and testing activities. This alternative includes changes in force structure (personnel, weapons, and assets) requirements, new or upgraded weapons and platforms, and the training and testing required for proficiency with these systems.

3.12.3.2.3.1 Training

Alternative 2 is identical to Alternative 1 in the increase and of activities over the No Action Alternative. As concluded under Alternative 1, impacts on public health and safety beyond those identified under the No Action Alternative would be unlikely.

3.12.3.2.3.2 Testing

Similar to the analysis under Alternative 1, Alternative 2 would involve an increase in electromagnetic energy and laser testing activities. Electromagnetic energy activities would occur in the Northeast, VACAPES, Navy Cherry Point, JAX, and GOMEX Range Complexes. Laser targeting activities, including high energy laser testing activities, would occur in the VACAPES and JAX Range Complexes. While Alternative 2 would adjust locations and tempo of testing activities involving electromagnetic energy and lasers, the Navy would continue implementation of standard operating and safety procedures; therefore, the potential for impacts on public health and safety beyond those identified under the No Action Alternative would be unlikely.

3.12.3.3 Physical Interactions

Public health and safety could be impacted by direct physical interactions with Navy activities. As described in Section 3.0.5.3.3 (Physical Disturbance and Strike Stressors), Navy aircraft, vessels, targets, munitions, towed devices, seafloor devices, and other training and testing expended materials could have a direct physical encounter with recreational, commercial, institutional, and governmental aircraft, vessels, and users such as swimmers, divers, and anglers.

Both Navy and public aircraft operate under visual flight rules requiring them to observe and avoid other aircraft. In addition, Notices to Airmen advise pilots about when and where Navy training and testing activities are scheduled. Finally, Navy personnel are required to verify that the range is clear of nonparticipants before initiating any potentially hazardous activity. Together, these procedures would minimize the potential for adverse interactions between Navy and nonparticipant aircraft. Because of standard operating procedures, private and commercial aircraft traversing the Study Area during training or testing activities are not subject to interactions with Navy aircraft, ordnance, and aerial targets.

Private and commercial vessels traversing the Study Area during training or testing activities are subject to interactions with Navy vessels, ordnance, and surface targets. 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 nonparticipants 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 be minimized, reducing the potential for collisions or ship strikes. 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 could pose a safety risk. The Navy would continue to recover targets at or near the surface used during training or testing to ensure they would not pose a collision 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 was completed, so they would not pose a collision 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.

As discussed in Section 3.1 (Sediments and Water Quality), a west coast study categorized types of marine debris pulled up by a trawler during a groundfish survey. Military expended materials categorized as plastic, metal, fabric and fiber, and rubber accounted for 7.4, 6.2, 13.2, and 4.7 percent of the total count of items collected, respectively. The footprint of military expended materials in the Study Area is discussed in Section 3.3.3.2.1 (Impacts from Military Expended Materials) of Marine Habitats. Tables 3.3-14 and 3.3-15 illustrate the very small percentage of marine substrate (much less than 1 percent of the total area of documented soft bottom 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 3.1 (Sediments and Water Quality) also discussed the low failure rate of munitions, which indicates that most munitions operate as intended. While fishing activities may encounter undetonated ordnance, it would be unlikely because of the low density of munitions within the large size of the Study Area. The Army Corps of Engineers prescribes the following if military munitions are encountered: recognize when you may have encountered a munition, retreat from the area without touching or disturbing the item, and report the item to local law enforcement by calling 911 or the U.S. Coast Guard.

The analysis focuses on the potential for a direct physical interaction with aircraft, vessels, targets, or other expended materials. Virtually all proposed activities have potential for a direct physical interaction that could pose a risk to public health and safety, so the following analysis is not activity-specific. While some of the activities themselves may not pose potential for a direct physical interaction (like pierside sonar testing), the platforms associated with the activity (aircraft, vessels, and towed devices) have potential for a direct physical interaction that could pose a risk. The greatest potential for a physical interaction would be along the coast because of the concentration of public activities.

3.12.3.3.1 No Action Alternative

3.12.3.3.1.1 Training

Under the No Action Alternative, training activities would continue at current levels and within current locations. The potential for a direct physical interaction between the public and aircraft, vessels, targets, or expended materials would not change from the baseline. 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.

The analysis indicates that there would be no impact on public health and safety from physical interactions with training activities, based on the Navy's implementation of strict 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 the No Action Alternative would be unlikely.

3.12.3.3.1.2 Testing

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 the No Action Alternative. As concluded above, because of the Navy's safety procedures, the potential for testing activities to impact public health and safety under the No Action Alternative would be unlikely.

3.12.3.3.2 Alternative 1

Alternative 1 consists of the activities in the No Action Alternative plus adjustments to locations and tempo of training and testing activities. This alternative includes changes in force structure (personnel, weapons, and assets) requirements, new or upgraded weapons and platforms, and the training and testing required for proficiency with these systems.

3.12.3.3.2.1 Training

Under Alternative 1, the number of training activities would increase. However, the increased number of aircraft and vessel movements or use of targets and expended materials would be conducted under the same safety and inspection procedures as under the No Action Alternative. While Alternative 1 would adjust locations and tempo of training activities, the Navy would continue implementation of standard operating and safety procedures; therefore, the potential for impacts on public health and safety beyond those identified under the No Action Alternative would be unlikely.

3.12.3.3.2.2 Testing

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 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.

3.12.3.3.3 Alternative 2 (Preferred Alternative)

Alternative 2 consists of the activities in the No Action Alternative plus adjustments to locations and tempo of training and testing activities. This alternative includes changes in force structure (personnel, weapons, and assets) requirements, new or upgraded weapons and platforms, and the training and testing required for proficiency with these systems.

3.12.3.3.3.1 Training

Under Alternative 2, the number of training activities would increase. However, the increased number of aircraft and vessel movements or use of targets and expended materials would be conducted under the same safety and inspection procedures as under the No Action Alternative. While Alternative 2 would adjust locations and tempo of training activities, the Navy would continue implementation of standard operating and safety procedures; therefore, the potential for impacts on public health and safety beyond those identified under the No Action Alternative would be unlikely.

3.12.3.3.3.2 Testing

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 be unlikely.

3.12.4 Summary of Potential Impacts

3.12.4.1 Indirect Impacts

Public health and safety could be impacted if there were changes to sediment or water quality. Section 3.1 (Sediments and Water Quality) considers the impacts on marine sediments and water quality from explosives and explosion byproducts, metals, chemicals other than explosives, and other materials (marine markers, flares, chaff, targets, and miscellaneous components of other materials). The analysis determined that neither state nor federal standards or guidelines would be violated by the No Action Alternative, Alternative 1, or Alternative 2. Because these standards and guidelines are structured to protect human health, and the proposed activities do not violate them, there would be no indirect impacts on public health and safety from the training and testing activities proposed by the No Action Alternative, Alternative 1, or Alternative 2.

3.12.4.2 Combined Impact of All Stressors

Activities described in this EIS/OEIS that have potential to impact public health and safety include those that release underwater energy, in-air energy, or physical interactions, or that have indirect impacts from changes to sediments and water quality. Under the No Action Alternative, Alternative 1, or Alternative 2, these activities would be widely dispersed throughout the Study Area. Such activities also are dispersed temporally (i.e., few stressors would be present at the same time). For these reasons, no greater effects from the combined operation of more than one stressor are expected. The aggregate effect on public health and safety would not observably differ from existing conditions.

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4 CUMULATIVE IMPACTS

4.1 INTRODUCTION

Analysis of cumulative impacts (or cumulative effects)[1] presented in this section follows the requirements of the National Environmental Policy Act (NEPA) and Council on Environmental Quality guidance (Council on Environmental Quality 1997). The Council on Environmental Quality regulations (40 Code of Federal Regulations [C.F.R.] Parts 1500-1508) provide the implementing regulations for NEPA. The regulations define cumulative impacts as

> "…the impact on the environment which results from the incremental impact of the action when added to the 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 C.F.R. § 1508.7)."

While a single project may have minor impacts, overall impacts may be collectively significant when the project is considered together with other projects on a regional scale. A cumulative impact is the additive effect of all projects in the geographic area. The Council on Environmental Quality provides guidance on cumulative impacts analysis in *Considering Cumulative Impacts under the National Environmental Policy Act* (Council on Environmental Quality 1997). This guidance further identifies cumulative impacts as those environmental impacts resulting "from spatial and temporal crowding of environmental perturbations. The impacts of human activities will accumulate when a second perturbation occurs at a site before the ecosystem can fully rebound from the impacts of the first perturbation." This guidance observes that "no universally accepted framework for cumulative impacts analysis exists" while noting that certain general principles have gained acceptance. The Council on Environmental Quality provides guidance on the extent to which agencies of the federal government are required to analyze the environmental impacts of past actions when they describe the cumulative environmental effect of an action. This guidance provides that an analysis of cumulative impacts might encompass geographic boundaries beyond the immediate area of an action and a timeframe that includes past actions and foreseeable future actions. Thus, the Council on Environmental Quality guidelines observe, "[it] is not practical to analyze cumulative impacts of an action on the universe; the list of environmental impacts must focus on those that are truly meaningful."

4.2 APPROACH TO ANALYSIS

4.2.1 OVERVIEW

Cumulative impacts were analyzed for each resource addressed in Chapter 3 (Affected Environment and Environmental Consequences) for the No Action Alternative, Alternative 1, and Alternative 2 (Preferred Alternative) in combination with past, present, and reasonably foreseeable future actions. The cumulative impacts analysis included the following steps, described in more detail below:

1. Identify appropriate level of analysis for each resource.
2. Define the geographic boundaries and timeframe for the cumulative impacts analysis.
3. Describe current resource conditions and trends.
4. Identify potential impacts of each alternative that might contribute to cumulative impacts.

[1] Council on Environmental Quality Regulations provides that the terms "cumulative effects" and "cumulative impacts" are synonymous (40 C.F.R. § 1508.8[b]); the terms are used interchangeably by various sources, but the term "cumulative impacts" is used in this document except for quotations, for continuity.

5. Identify past, present, and other reasonably foreseeable future actions that affect each resource.
6. Analyze potential cumulative impacts.

4.2.2 Identify Appropriate Level of Analysis for Each Resource

In accordance with Council on Environmental Quality guidance (Council on Environmental Quality 1997), the cumulative impacts analysis focused on impacts that are "truly meaningful." The level of analysis for each resource was commensurate with the intensity of the impacts identified in Chapter 3 (Affected Environment and Environmental Consequences). The rationale for the level of analysis applied to each resource is described in Section 4.4 (Resource-Specific Cumulative Impacts).

4.2.3 Define the Geographic Boundaries and Timeframe for Analysis

The geographic boundaries for the cumulative impacts analysis included the entire Atlantic Fleet Training and Testing (AFTT) Study Area (Study Area) (Figure 2.1-1). The geographic boundaries for marine mammals and sea turtles were expanded to include activities that might impact migratory marine mammals and sea turtles. Primary considerations from outside the Study Area include impacts associated with maritime traffic (e.g., vessel strikes and underwater noise) and commercial fishing (e.g., bycatch and entanglement).

Determining the timeframe for the cumulative impacts analysis requires estimating the length of time the impacts of the Proposed Action would last (Council on Environmental Quality 1997) and considering the specific resource in terms of its history of degradation. The Proposed Action includes ongoing and anticipated future training and testing activities. While Navy training and testing requirements change over time in response to world events and several other factors, the general types of activities addressed by this Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) 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). Therefore, the cumulative impacts analysis is not bounded by a specific future timeframe. For past actions, the cumulative impacts analysis only considers those actions or activities that have ongoing impacts.

While the cumulative impacts analysis is not limited by a specific timeframe, 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. The Navy submitted applications to the National Marine Fisheries Service (NMFS) for Marine Mammal Protection Act (MMPA) authorizations supported by this EIS/OEIS. The anticipated effective date for these MMPA authorizations would be in December 2013. 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.

4.2.4 Describe Current Resource Conditions and Trends

The Affected Environment sections of Chapter 3 describe current resource conditions and trends, and they discuss how past and present human activities influence each resource. The current aggregate impacts of past and present actions are reflected in the baseline information presented in Chapter 3

(Affected Environment and Environmental Consequences). This information is used in the cumulative impacts analysis to understand how past and present actions are currently impacting each resource and to provide the context for the cumulative impacts analysis.

4.2.5 Identify Potential Impacts of the Alternatives That Might Contribute to Cumulative Impacts

Direct and indirect impacts of the alternatives, presented in Chapter 3 (Affected Environment and Environmental Consequences), were reviewed to identify impacts relevant to the cumulative impacts analysis. Key factors considered included the current status and sensitivity of the resource and the intensity, duration, and spatial extent of the impacts for each stressor. In general, long-term rather than short-term impacts and widespread rather than localized impacts were considered more likely to contribute to cumulative impacts. For example, for biological resources, population-level impacts were considered more likely to contribute to cumulative impacts than were individual-level impacts. Negligible impacts were not considered further in the cumulative impacts analysis. For marine mammals, any stressor that is expected to result in Level A harassment or Level B harassment, as defined by MMPA, was considered in the cumulative impacts analysis. For Endangered Species Act (ESA)-listed species, any stressor that may affect and is likely to adversely affect the species was considered in the cumulative impacts analysis. Stressors that were determined by the Navy to have no effect or that may affect but are not likely to adversely affect ESA-listed species were not analyzed in detail in the cumulative impacts analysis. A determination of may affect, not likely to adversely affect indicates that the impacts would be discountable (extremely unlikely) or insignificant.

4.2.6 Identify Other Actions and Other Environmental Considerations That Affect Each Resource

A list of other actions was compiled for the Study Area and surrounding areas based on information obtained during the scoping process (Appendix E, Public Comments and Responses), communications with other agencies, a review of other military activities, literature review, previous NEPA analyses for some of the other actions, and other available information. Identified future actions were reviewed to determine if they should be considered further in the cumulative impacts analysis. Factors considered when identifying other actions to be included in the cumulative impacts analysis included the following:

- Whether the other action is likely or probable (i.e., reasonably foreseeable), rather than merely possible or speculative.
- The timing and location of the other action in relationship to proposed training and testing activities.
- Whether the other action and each alternative would affect the same resources.
- The current conditions, trends, and vulnerability of resources affected by the other action.
- The duration and intensity of the impacts of the other action.
- Whether the impacts have been truly meaningful, historically significant, or identified previously as a cumulative impact concern.

In addition to identifying reasonably foreseeable future actions, other environmental considerations for the cumulative impacts analysis were identified and described. These other considerations include major environmental stressors or issues (e.g., ocean pollution, ocean noise, coastal development, etc.) that tend to be widespread and arise from routine human activities and multiple past, present, and future actions. Including these other environmental considerations allows an analysis of the current aggregate impacts of past and present actions, as well as reasonably foreseeable actions.

4.2.7 Analyze Potential Cumulative Impacts

The current impacts of past and present actions and the anticipated impacts of reasonably foreseeable future actions were characterized and summarized. The incremental impacts of each alternative were then added to the combined impacts of all other actions to describe the cumulative impacts that could result if the No Action Alternative, Alternative 1, or Alternative 2 were implemented. The cumulative impacts analysis considered additive, synergistic, and antagonistic impacts. A qualitative analysis was conducted in most cases based on the available information. The analysis in Chapter 3 (Affected Environment and Environmental Consequences) indicates that the direct and indirect impacts of the No Action Alternative, Alternative 1, and Alternative 2 would be similar for many of the stressors. Therefore, much of the cumulative impacts discussion applies to all three alternatives. Specific differences between the alternatives are discussed when appropriate.

4.3 Other Actions Analyzed in the Cumulative Impacts Analysis

4.3.1 Overview

Table 4.3-1 lists the other actions and other environmental considerations identified for the cumulative impacts analysis. Descriptions of each action and environmental consideration carried forward for analysis are provided in the following sections.

Table 4.3-1: Other Actions and Other Environmental Considerations Identified for the Cumulative Impacts Analysis

#	Name of Action	Lead Agency or Proponent	Location	Timeframe	Retained for Further Analysis?
Oil and Natural Gas Exploration, Extraction, and Production					
1	Outer Continental Shelf Oil and Gas Leasing Program	Bureau of Ocean Energy Management	Gulf of Mexico LME	Past, present, and future	Retained
2	Seismic Surveys	Bureau of Ocean Energy Management, oil and gas industry, National Science Foundation, and academic institutions	Entire Study Area, all LMEs, and open ocean areas	Past, present, and future	Retained
3	Installation of Floating, Production, Storage, and Offloading Systems	Bureau of Ocean Energy Management	Gulf of Mexico LME	Past, present, and future	Retained
4	Structure-Removal Operations on the Gulf of Mexico Outer Continental Shelf	Bureau of Ocean Energy Management	Gulf of Mexico LME	Past, present, and future	Retained
5	Liquefied Natural Gas Terminals	Federal Energy Regulatory Commission, Maritime Administration, and U.S. Coast Guard	Northeast U.S. Continental Shelf LME, Southeast U.S. Continental Shelf LME, and Gulf of Mexico LME	Past, present, and future	Retained
6	Commercial Wind Lease Issuance and Site Assessment Activities	Bureau of Ocean Energy Management	Northeast U.S. Continental Shelf LME and Southeast U.S. Continental Shelf LME	Future	Retained
7	Cape Wind Energy Project	Bureau of Ocean Energy Management Cape Wind Associates, LLC	Northeast U.S. Continental Shelf LME	Future	Retained

LME: large marine ecosystem

Table 4.3-1: Other Actions and Other Environmental Considerations Identified for the Cumulative Impacts Analysis (Continued)

#	Name of Action	Lead Agency or Proponent	Location	Timeframe	Retained for Further Analysis?
Offshore Power Generation					
8	Fishermen's Atlantic City Wind Farm	New Jersey State Agencies, U.S. Army Corps of Engineers, Fishermen's Wind Energy of New Jersey	Northeast U.S. Continental Shelf LME	Future	Retained
9	Interim Policy Leases on the Atlantic Outer Continental Shelf – Fisherman's Energy of New Jersey, Bluewater Delaware, and Bluewater Wind New Jersey Energy	Bureau of Ocean Energy Management, Fisherman's Energy of New Jersey, Bluewater Delaware, and Bluewater Wind New Jersey Energy	Northeast U.S. Continental Shelf LME	Future	Retained
10	Electrical Transmission Lines	Bureau of Ocean Energy Management, Atlantic Grid Holdings	Northeast U.S. Continental Shelf LME	Future	Retained
11	Wave and Tidal Energy Plants	Bureau of Ocean Energy Management	Northeast U.S. Continental Shelf LME, Southeast U.S. Continental Shelf LME, and Gulf of Mexico LME	Future	Dismissed because action is speculative
Dredge Disposal, Beach Nourishment, and Mining					
12	Offshore Dredge Disposal Program	U.S. Army Corps of Engineers	All LMEs	Past, present, and future	Retained
13	Beach Nourishment Programs	U.S. Army Corps of Engineers	All LMEs	Past, present, and future	Retained
14	Sand and Gravel Mining	Bureau of Ocean Energy Management	All LMEs	Past, present, and future	Retained

LME: large marine ecosystem.

Table 4.3-1: Other Actions and Other Environmental Considerations Identified for the Cumulative Impacts Analysis (Continued)

#	Name of Action	Lead Agency or Proponent	Location	Timeframe	Retained for Further Analysis?
Other Military Activities					
15	Construction of the Undersea Warfare Training Range	U.S. Navy	Southeast U.S. Continental Shelf LME	Future (start construction fiscal year 2014)	Retained
16	Military Training at Eglin Air Force Base and Eglin Gulf Test and Training Range	U.S. Navy and U.S. Air Force	Gulf of Mexico LME	Present and future	Retained
17	Surveillance Towed Array Sensor System Low Frequency Active Sonar	U.S. Navy	All LMEs	Future	Retained
18	Air-to-Surface Training at Long Shoal Naval Ordnance Area	U.S. Navy	Inshore water of Pamlico Sound, North Carolina	Past, present, and future	Dismissed. Training would be outside the Study Area and would not involve the use of high explosive ordnance. Use of the target would be intermittent and potential impacts to marine animals would be short-term, local, and negligible to minor. Proposed training may affect, but is not likely to adversely affect ESA-listed species.
19	Joint Logistics Over-the-Shore Training	U.S. Navy, Marine Corps, and Army	Northeast and Southeast U.S. Continental Shelf LMEs	Future	Retained. Training activities associated with elevated causeway set up and break down are addressed under Alternatives 1 and 2 of this EIS/OEIS. Land-based training, including potential impacts to nesting sea turtles, will be addressed in separate NEPA documents by the other services.
20	Littoral Combat Ship Homeporting	U.S. Navy	Northeast and Southeast U.S. Continental Shelf LMEs	Future	Dismissed. Littoral Combat Ship training is considered under Alternatives 1 and 2 of this EIS/OEIS. While NEPA has not been completed and a decision has not been made, the Navy's envisaged homeporting locations for the Atlantic Fleet Littoral Combat Ships are Naval Station Mayport (primary) and Naval Station Norfolk (tertiary). No in water construction is anticipated for either of these ports; therefore, the potential for cumulative impacts from homeporting are negligible.

EIS: Environmental Impact Statement; ESA: Endangered Species Act; LME: large marine ecosystem; NEPA: National Environmental Impact Statement; OEIS: Overseas Environmental Impact Statement.

Table 4.3-1: Other Actions and Other Environmental Considerations Identified for the Cumulative Impacts Analysis (Continued)

#	Name of Action	Lead Agency or Proponent	Location	Timeframe	Retained for Further Analysis?
Other Military Activities (Continued)					
21	Nuclear-Powered Aircraft Carrier Homeporting at Naval Station Mayport	U.S. Navy	Southeast U.S. Continental Shelf LME	Future	Retained for potential impacts associated with development activities to accommodate the carrier at Naval Air Station Mayport (e.g., dredging, increases in vessel traffic, underwater noise, etc.). Training activities are part of the Proposed Action for this EIS/OEIS.
22	Tactical Air Crew Combat Training System Tower Removal	U.S. Navy	Northeast and Southeast U.S. Continental Shelf LMEs	Future	Dismissed. Impacts associated with removing these communication towers from at-sea ranges are expected to be temporary, local, and negligible to minor.
23	U.S. Navy Climate Change Roadmap	U.S. Navy	All LMEs	Present and future	Retained
24	U.S. Marine Corps Grow the Force at Marine Corps Base Camp Lejeune, Marine Corps Air Station New River, and Marine Corps Air Station Cherry Point, North Carolina	U.S. Marine Corps	Southeast U.S. Continental Shelf LME	Present and future	Dismissed. The action includes relocation of Marines and associated construction on land. No impacts on marine resources were identified in the EIS.
25	U.S. Marine Corps training at Camp Lejeune and Marine Corps Air Station Cherry Point	U.S. Marine Corps	Southeast U.S. Continental Shelf LME	Past, present, and future	Dismissed. Most activities would occur on land. The Environmental Assessments for these actions concluded that impacts of in-water activities on marine resources would be negligible to minor and that in-water activities may affect but are not likely to adversely affect ESA-listed species.
26	U.S. Marine Corps Joint Strike Fighter	U.S. Marine Corps	All LMEs	Future	Dismissed. Homebasing activities such as new construction and personnel relocation are not expected to impact marine resources. Joint Strike Fighter training activities are addressed under Alternatives 1 and 2.
27	U.S. Air Force Aircraft Training from Langley Air Force Base	U.S. Air Force	Northeast U.S. Continental Shelf LME	Past, present, and future	Dismissed. Over-water activities are limited to aircraft overflights.

EIS: Environmental Impact Statement; ESA: Endangered Species Act; LME: large marine ecosystem; OEIS: Overseas Environmental Impact Statement.

Table 4.3-1: Other Actions and Other Environmental Considerations Identified for the Cumulative Impacts Analysis (Continued)

#	Name of Action	Lead Agency or Proponent	Location	Timeframe	Retained for Further Analysis?
Other Military Activities (Continued)					
28	Training Conducted by U.S. Army Vessels from Fort Eustis	U.S. Army	Northeast U.S. Continental Shelf LME	Past, present, and future	Retained
29	Homeporting of U.S. Coast Guard National Security Cutter and Other Ships at Naval Air Station Mayport	U.S. Coast Guard and U.S. Navy	Southeast U.S. Continental Shelf LME	Future	Retained
30	U.S. Coast Guard Training Conducted from Various Coast Guard Stations along the East Coast, Caribbean, and Gulf of Mexico	U.S. Coast Guard	All LMEs	Past, present, and future	Retained
Environmental Regulations and Planning					
31	Expansion of North Atlantic Right Whale Critical Habitat – National Marine Fisheries Service	National Marine Fisheries Service	Northeast U.S. Continental Shelf LME and Southeast U.S. Continental Shelf LME	Future	Retained
32	Coastal and Marine Spatial Planning	Regional Planning Bodies	All LMEs	Future	Dismissed because action involves only planning and policy-related activities; specific future actions are speculative.
33	Marine Mammal Protection Act Incidental Take Authorizations	National Marine Fisheries Service	All LMEs	Past, present, and future	Retained

LME: large marine ecosystem.

Table 4.3-1: Other Actions and Other Environmental Considerations Identified for the Cumulative Impacts Analysis (Continued)

#	Name of Action	Lead Agency or Proponent	Location	Timeframe	Retained for Further Analysis?
Other Environmental Considerations					
34	Commercial Fishing and Fishery Management Plans	National Marine Fisheries Service and private industry	All LMEs and open ocean areas	Past, present, and future	Retained
35	Maritime Traffic (including Panama Canal Widening and U.S. Coast Guard Atlantic Coast Port	Not applicable	All LMEs and open ocean areas	Past, present, and future	Retained
36	Maritime Traffic – Panama Canal Widening	Panama Canal Authority	All LMEs	Future	Retained
37	Maritime Traffic – U.S. Coast Guard Atlantic Coast Port Access Route Study	U.S. Coast Guard	All LMEs	Future	Retained
38	Ocean Noise	Not applicable	All LMEs and open ocean areas	Past, present, and future	Retained
39	Ocean Pollution (including Marine Debris, Nonpoint Source Pollution, and Cruise Ship Discharges)	Not applicable	All LMEs and open ocean areas	Past, present, and future	Retained
40	Commercial and General Aviation	Not applicable	All LMEs and open ocean areas	Past, present, and future	Retained for greenhouse gas emission analysis

LME: large marine ecosystem.

4.3.2 Oil and Natural Gas Exploration, Extraction, and Production

4.3.2.1 Outer Continental Shelf Oil and Gas Leasing Programs

The Bureau of Ocean Energy Management administers Outer Continental Shelf Oil and Gas Leasing Programs. As of 1 April 2011, there were 6,323 active oil and gas leases totaling 33,905,799 acres in the Gulf of Mexico Continental Shelf Oil Region (Western Planning Area, 1,403 leases and 7,889,290 acres leased; Central Planning Area, 4,805 leases and 25,397,566 acres leased; and Eastern Planning Area, 115 leases and 618,944 acres leased) (Bureau of Ocean Energy Management 2011c). Oil and gas exploration and production may occur in these areas.

On 1 December 2010, Secretary of the Interior Ken Salazar announced an updated oil and gas leasing strategy for the Outer Continental Shelf. Based on lessons learned from the *Deepwater Horizon* oil spill, the United States (U.S.) Department of the Interior increased the requirements in the drilling and production stages for equipment, safety, environmental safeguards, and oversight. To implement these reforms efficiently and effectively, critical agency resources will be focused on planning areas that currently have leases for potential future development. As a result, areas in the eastern Gulf of Mexico subject to the congressional moratorium on oil and gas exploration and production activities will not be considered for potential leasing before 2017. In addition, the Mid- and South Atlantic Planning Areas are no longer under consideration for potential development through 2017. The western Gulf of Mexico, the central Gulf of Mexico, the Cook Inlet, and the Chukchi and Beaufort Seas in the Arctic will continue to be considered for potential leasing before 2017 (U.S. Department of the Interior 2010).

4.3.2.2 Seismic Surveys

Seismic surveys are typically accomplished by towing a sound source such as an airgun array that emits acoustic energy in timed intervals behind a research vessel. The transmitted acoustic energy is reflected and received by an array of hydrophones. This acoustic information is processed to provide information about geological structure below the seafloor. The oil and gas industry uses seismic surveys to search for new hydrocarbon deposits. In addition, academic geologists use them to study plate tectonics and other topics. 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. The underwater sound produced by these surveys could affect marine life, including marine mammals. For example, the potential exists to expose some animals to sound levels exceeding 180 decibels (dB) referenced to (re) 1 micropascal (μPa) (root mean square), which would in turn potentially cause temporary or permanent loss of hearing (Bureau of Ocean Energy Management 2011a).

Seismic surveys conducted by the oil and gas industry on the Outer Continental Shelf are regulated and permitted by the Bureau of Ocean Energy Management. Its *Programmatic Environmental Assessment for Geological and Geophysical Exploration for Mineral Resources on the Gulf of Mexico Outer Continental Shelf* was completed in 2004, and the *Draft Programmatic Environmental Impact Statement for Atlantic Outer Continental Shelf Proposed Geological and Geophysical Activities in the Mid-Atlantic and South Atlantic Planning Areas* was released in March 2012 (Bureau of Ocean Energy Management 2012a). All seismic surveys conducted by U.S. vessels are subject to the MMPA authorization process administered by the NMFS, as well as the NEPA process associated with issuing MMPA authorizations.

From 1968 through 2003, approximately 997,901 line miles (mi.) of two-dimensional seismic data were collected in the Gulf of Mexico region, and 212,967 line mi. were collected in the Atlantic region (Minerals Management Service 2005a). As of April 2011, the Bureau of Ocean Energy Management had received nine applications for Atlantic Outer Continental Shelf seismic survey activities totaling 317,494 line mi.

4.3.2.3 Installation of Floating, Production, Storage, and Offloading Systems

The U.S. Department of the Interior, Minerals Management Service (now named the Bureau of Ocean Energy Management), prepared an EIS to evaluate potential environmental impacts of the proposed use of floating production, storage, and offloading systems in the deepwater portions (depths greater than 200 meters [m]) of the Western and Central Planning Areas of the Gulf of Mexico Outer Continental Shelf. Floating production systems would store crude oil in tanks in the hulls of vessels and would periodically offload the crude to shuttle tankers or ocean-going barges for transport to shore. The Record of Decision was signed 13 December 2001. The general concept of these systems was approved, although no specific installation was authorized in the planning document.

On 17 March 2011, the Bureau of Ocean Energy Management provided final approval necessary for Petrobras America, Inc. to begin oil and natural gas production at its Cascade-Chinook project in the Walker Ridge area of the Gulf of Mexico. The project started production in September 2012 (Offshore Energy Today 2012). Located approximately 165 mi. (265.5 kilometers [km]) from Louisiana in approximately 2,500 m of water, the project is the first deepwater floating production storage offloading facility approved in the United States. The facility has the capability to process oil and natural gas, store the crude oil in tanks in the facility's hull, and offload the crude to shuttle tankers for transportation to shore. Natural gas processed by the facility will be transported to shore by pipeline (Bureau of Ocean Energy Management 2011b).

4.3.2.4 Liquefied Natural Gas Terminals

In recent years, liquefied natural gas terminals have been proposed at several locations throughout the Atlantic coast and nearshore waters of the Gulf of Mexico in response to the quickly escalating domestic demand for natural gas. Table 4.3-2 provides a summary of existing and proposed offshore terminals in the Study Area. Several existing terminals are in coastal waters near the Study Area, and others are proposed (Federal Energy Regulatory Commission 2011).

Table 4.3-2: Existing and Proposed Offshore Liquefied Natural Gas Terminals in the Atlantic Fleet Training and Testing Study Area

Facility Name	Location	Status
Gulf Gateway Energy Bridge	Gulf of Mexico, 116 miles offshore of Louisiana	Operational since 2005
Louisiana Offshore Oil Port	Gulf of Mexico, 16 miles southeast of Port Fourchon, Louisiana	Operational since 1981
Neptune Liquefied Natural Gas	Massachusetts Bay, 10 miles south of Gloucester, Massachusetts	Operational since 2010
Northeast Gateway	Massachusetts Bay, 13 miles south-southeast of Gloucester, Massachusetts	Operational since 2008
Port Dolphin	Gulf of Mexico, 28 miles offshore of the Tampa Bay area of Florida	Proposed. License issued in 2010. Construction could start in 2013, pending federal and state authorizations and permits for construction and operation.

Sources: Maritime Administration 2011, 2013

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. Releases of liquefied natural gas can result from equipment leaks or spills during operations. Releases can be accidental (e.g., ship collision) or intentional (e.g., sabotage or terrorist acts).

4.3.2.5 Structure-Removal Operations on the Gulf of Mexico Outer Continental Shelf

The former Minerals Management Service (now named the Bureau of Ocean Energy Management) prepared a Programmatic Environmental Assessment to determine the potential impacts that may result from decommissioning activities related to the explosive and non-explosive severing of seafloor obstructions (i.e., wellheads, caissons, casing strings, platforms, mooring devices, etc.) and the subsequent salvage and site-clearance operations that may occur. Decommissioning operations generally occur after lease expiration, when the well or facility is deemed economically unviable, or when the physical condition of the structure becomes unsafe or a navigation hindrance (Minerals Management Service 2005b).

4.3.3 Offshore Wind Energy

4.3.3.1 Commercial Wind Lease Issuance and Site Assessment Activities

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 and U.S. Department of Interior 2011). This strategy details an initiative to achieve a scenario of 54 gigawatts of deployed offshore wind-generating capacity by 2030, with an interim scenario of 10 gigawatts of capacity deployed by 2020. In 2007, the Minerals Management Service prepared a final programmatic EIS in support of the establishment of its program for authorizing alternative energy and alternate use activities on the Outer Continental Shelf (Minerals Management Service 2007). The programmatic EIS examined the potential environmental effects of the program and identified policies and best management practices that may be adopted for the program. 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. 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 NEPA review (typically an EIS) is conducted, and construction and operation plans are approved before beginning construction of individual wind power facilities.

Table 4.3-3 summarizes the status of offshore wind energy siting, leasing, and proposed construction in the Study Area as of March 2013. Two wind energy projects, Cape Wind Energy and Fishermen's Atlantic City Windfarm, have been approved within the Study Area, but construction had not started as of March 2013.

Table 4.3-3: Status of Offshore Wind Energy Siting, Leasing, and Construction in the Study Area as of March 2013

State	Status
Maine	• Statoil North America Inc. submitted an unsolicited request for a commercial lease. • Potential commercial leasing request for interest published August 2012. • Notice of intent to prepare an EIS published August 2012.
Massachusetts	• Environmental assessment for wind energy area prepared November 2012. • The Cape Wind Energy project calls for 130 wind turbine generators, each with a maximum blade height of 440 ft. (134 m), to be arranged in a grid pattern on the Outer Continental Shelf in Nantucket Sound, offshore of Cape Cod, Martha's Vineyard, and Nantucket Island. The Bureau of Ocean Energy Management approved a construction and operations plan for the project on 19 April 2011 (U.S. Department of the Interior 2011).
Rhode Island	• Environmental assessment for wind energy area prepared July 2012. • Proposed lease sale notice issued November 2012.
New Jersey	• Four interim policy leases issued November 2009 to Deepwater Wind, Fishermen's Energy of New Jersey, and Bluewater Wind New Jersey Energy. The Bluewater Wind Energy of New Jersey lease was relinquished effective October 2012. • The Fishermen's Atlantic City Windfarm, which is proposed in state waters 2.8 miles offshore of Atlantic City, was approved by the New Jersey Department of Environmental Protection in 2011 (Fisherman's Energy of New Jersey 2011). The U.S. Army Corps of Engineers issued a permit in July 2012. Target date to start construction is 2013 (Fisherman's Energy of New Jersey 2012).
Delaware	• A lease with Bluewater Wind Delaware was executed November 2012.
Maryland	• Call for information and nominations published February 2012.
Virginia	• Proposed lease sale notice published December 2012.
North Carolina	• Call for information and nominations published December 2012.
Georgia	• Southern Company submitted an interim policy lease application April 2011. • Notice of intent to prepare an environmental assessment published December 2012.
Florida	• Environmental assessment for interim policy lease prepared April 2012.

Source: Bureau of Ocean Energy Management 2013, unless otherwise noted.
EIS: Environmental Impact Statement; ft.: feet

With the exception of the two approved projects, most activities over the next five years are expected to include site characterization and assessment. Site characterization activities would include high-resolution geophysical surveys for the collection of data about shallow hazards, archaeological resources, and bathymetry; sub-bottom sampling; and biological surveys. Site assessment activities would include installation of meteorological towers and meteorological buoys, data collection, and decommissioning of the towers and buoys. Potential impacts include intermittent underwater noise associated with geophysical surveys, subbottom sampling, and construction and decommissioning of the meteorological towers and buoys; bottom disturbance associated with tower construction and decommissioning; and increased vessel traffic. The Bureau of Ocean Energy Management would require leases to conduct site characterization and assessment activities in accordance with mandatory project design criteria to eliminate or minimize potential impacts on marine mammals and sea turtles. Informal ESA consultations were conducted with NMFS and the U.S. Fish and Wildlife Service. The agencies concurred that the proposed activities may affect but are not likely to adversely affect ESA-listed species if mandatory project design criteria are implemented. Lessees would be required to obtain MMPA authorizations from NMFS before starting certain site characterization and assessment activities. The MMPA authorizations may require additional measures to protect marine mammals (Bureau of Ocean Energy Management 2012b).

4.3.3.2 Electrical Transmission Lines

In March 2011, the Bureau of Ocean Energy Management received an unsolicited right-of-way grant application from Atlantic Grid Holdings for a subsea backbone transmission system (referred to as the Atlantic Wind Connection project) in state waters and on the Outer Continental Shelf offshore of New York, New Jersey, Delaware, Maryland, and Virginia. The purpose of the project is to transmit electricity generated by future offshore commercial wind facilities to onshore markets. The project would include nine offshore electrical converter platforms and 756 mi. of cabling, with 650 mi. on the Outer Continental Shelf, 38 mi. in state waters, and 67 mi. on shore. Atlantic Grid Holdings estimates construction would occur over approximately 10 years, and the entire system could be operational by 2021 (Bureau of Ocean Energy Management 2012b).

4.3.4 Other Military Actions

4.3.4.1 Construction of the Undersea Warfare Training Range

On 5 August 2009, the Navy published its Record of Decision regarding the construction of an undersea warfare training range in the Jacksonville Operating Area (OPAREA) (U.S. Department of the Navy 2009). Construction is anticipated to start in fiscal year 2014, and initial operational capability is anticipated in fiscal year 2019. Potential impacts of constructing the range are considered in the cumulative impacts analysis. Training activities on the range are included in Alternatives 1 and 2 and are analyzed as part of the Proposed Action.

4.3.4.2 Training Activities at Eglin Gulf Test and Training Range

The U.S. Air Force Eglin Gulf Test and Training Range consists of 124,642 square miles (mi.^{2}) of special use airspace over the Gulf of Mexico, which supports a variety of military readiness activities. The range is east of the Navy's Gulf of Mexico (GOMEX) Range Complex and north of the Key West Range Complex. Current and future testing and training activities expected to have impacts relevant to this cumulative impacts analysis include the following:

- U.S. Air Force air-to-surface gunnery exercises, which include the use of explosive rounds. An incidental harassment authorization issued by NMFS for these activities on 26 September 2011 is valid through 25 September 2012. Mitigation measures are required, and incidental taking by Level B harassment is authorized for dwarf sperm whale, pygmy sperm whale, Atlantic bottlenose dolphin, Atlantic spotted dolphin, pantropical spotted dolphin, and spinner dolphin.
- Precision strike weapon testing missions involve air-to-surface impacts of the Joint Air-to-Surface Stand-off Missile and the small-diameter bomb. These result in air and underwater detonations of up to 300 pounds (lb.) and 96 lb. of net explosive weight, respectively. Up to two high-explosive and four non-explosive missiles per year may be launched from an aircraft and as many as 6 high-explosive and 12 non-explosive small-diameter bombs can be dropped on targets annually. Detonation of the Joint Air-to-Surface Stand-off Missile and the small-diameter bomb has the potential for causing harassment, injury, or mortality to four species of marine mammals: Atlantic bottlenose dolphins, Atlantic spotted dolphins, dwarf sperm whales, and pygmy sperm whales. However, because of implementation of mitigation and monitoring measures, takings are expected to be limited to Level B harassment in the form of a temporary

change in the hearing threshold in the dolphin and whale species that might be in the vicinity of the detonations.

- Surf zone, amphibious vehicle, and weapons testing/training on Santa Rosa Island off the Florida coast include detonation of high-explosives in shallow water. Impacts on marine mammals are expected to be limited to Level B harassment. On 25 July 2008, NMFS issued an incidental harassment authorization to Eglin Air Force Base to conduct surf zone testing/training and amphibious and weapons testing/training from Santa Rosa Island for one year.
- Naval Explosive Ordnance Disposal School training includes underwater detonations of small (5 to 10 lb. net explosive weight) high-explosive charges. NMFS published a proposed rule for the incidental taking of marine mammals associated with these activities on 1 October 2010.

4.3.4.3 Surveillance Towed Array Sensor System Low Frequency Active Sonar

In August 2012, the Navy released a Record of Decision for the Final Supplemental EIS/Supplemental OEIS that evaluated the potential environmental impacts of employing the Surveillance Towed Array Sensor System Low Frequency Active Sonar. The Navy currently plans to operate up to four Surveillance Towed Array Sensor System Low Frequency Active Sonar systems for routine training, testing, and military operations. Based on current Navy national security and operational requirements, routine training, testing, and military operations using these sonar systems could occur in the Pacific Ocean, Atlantic Ocean (including the Study Area), Indian Ocean, and Mediterranean Sea.

4.3.4.4 Joint Logistics Over-the-Shore Training

Joint Logistics Over-The-Shore training consists of loading/unloading ships without fixed port facilities. This training may be conducted jointly by the Navy, Marine Corps, and Army at Joint Base Little Creek-Fort Story, Virginia or at Camp Lejeune, North Carolina, and includes in-water and land-based activities. Training activities associated with elevated causeway set up and break down are addressed under Alternatives 1 and 2 of this EIS/OEIS. Land-based training, including potential impacts to nesting sea turtles, will be addressed in separate NEPA documents by the other services.

4.3.4.5 Nuclear-Powered Aircraft Carrier Homeporting at Naval Station Mayport

In a Record of Decision dated 14 January 2009, the Navy announced it wants to establish a second Atlantic Fleet nuclear-powered aircraft carrier (CVN) home port by homeporting a CVN at Naval Station Mayport, Florida. Later that month, following the change in administrations, Obama Administration officials testified they would review the proposal. On 10 April 2009, the Department of Defense announced it had decided to delay a final decision on whether to propose transferring a CVN to Mayport until it reviewed the issue as part of its 2010 Quadrennial Defense Review. The Department of Defense's final report on the 2010 Quadrennial Defense Review, released 1 February 2010, endorsed the Navy's desire to establish a second Atlantic Fleet CVN home port by homeporting a CVN at Mayport (O'Rourke 2012).

The proposal requires certain facility upgrades to make Naval Station Mayport capable of homeporting a CVN, including dredging and construction of nuclear propulsion plant maintenance facilities. Potential cumulative impact issues associated with the homeporting action include increased vessel traffic and noise during construction and dredging. Training activities to be conducted by the relocated CVN are part of the Proposed Action for this EIS/OEIS.

Navy plans called for having Mayport ready to homeport a CVN in 2019. However, the current schedule is uncertain because the Navy's proposed fiscal year 2013 budget defers the Navy's plan to homeport a

CVN at Naval Station Mayport. The Navy's proposed fiscal year 2013 budget and the fiscal year 2013 to fiscal year 2017 Future Years Defense Plan contain no funding for Military Construction projects required to homeport a CVN at Mayport.

4.3.4.6 Training Conducted by U.S. Army Vessels from Fort Eustis

The Army conducts approximately 10 surface-to-surface gunnery training events per year in the Virginia Capes Range Complex (Warning Area 50). A representative training event includes firing approximately 2,400 rounds (.50 caliber) from a Landing Craft Utility vessel at floating, plastic drum targets, which are recovered after use. As discussed for the Proposed Action, modeling results indicate a high level of certainty that marine mammals or sea turtles would not be struck by military expended materials during Navy training activities.

4.3.4.7 Homeporting of U.S. Coast Guard National Security Cutter and Other Ships at Naval Station Mayport

The Coast Guard is proposing to homeport the U.S. Coast Guard Cutter VALIANT at Naval Station Mayport, Florida, possibly starting in summer 2013. VALIANT is a multi-mission, medium endurance cutter currently homeported in Miami Beach, Florida. VALIANT operates in the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico for Commander, Coast Guard Atlantic Area. Missions include search and rescue, maritime law enforcement, marine environmental protection, and national defense operations. In November 2011, the Coast Guard also requested assistance from the Navy in determining the feasibility of homeporting several ship classes at Naval Station Mayport, including all or some of the following: two National Security Cutters and four additional medium endurance cutters. Potential cumulative impacts issues associated with these possible actions include a slight increase in vessel traffic and increases in training activities. While specific training activities associated with the homeporting are not yet identified, it is possible that surface-to-surface gunnery training would be conducted by Coast Guard vessels in the Jacksonville Range Complex. As discussed for the Proposed Action, modeling results indicate a high level of certainty that marine mammals or sea turtles would not be struck by military expended materials during Navy training activities.

4.3.4.8 U.S. Coast Guard Training Conducted from Various Coast Guard Stations Along the East Coast, Caribbean, and Gulf of Mexico

The U.S. Coast Guard provides maritime humanitarian, law enforcement, and safety services to the people of the United States. These services are performed in estuarine, coastal, and offshore waters throughout the Study Area, which includes 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 (Louisiana to Texas). Numerous Coast Guard stations are located in each district. U.S. Coast Guard training activities conducted in the Study Area include boat and ship exercises that contribute to vessel noise and could result in collisions with marine mammals and sea turtles; fixed-wing aircraft and helicopter activities that contribute noise; and gunnery training that contributes military expended materials to the benthic environment and is a potential strike risk to marine life. Other expendables such as signal flares and marine markers are also used during U.S. Coast Guard training.

4.3.5 Expansion of North Atlantic Right Whale Critical Habitat

NMFS announced a determination that it is timely and appropriate to revise the 1994 designation of critical habitat for North Atlantic right whales (6 October 2010). As of March 2013, NMFS had not yet published a proposed rule in the Federal Register for expansion of North Atlantic right whale critical habitat.

4.3.6 COMMERCIAL FISHING

Commercial fishing constitutes an important and widespread use of the ocean resources throughout the Study Area. Commercial fishing can adversely affect fish populations, other species, and habitats. Potential impacts of commercial fishing include overfishing of targeted species and bycatch, both of which negatively affect fish stocks and other marine resources. Bycatch is the capture of fish, marine mammals, sea turtles, seabirds, and other nontargeted species that occur incidental to normal fishing operations. Use of mobile fishing gear, such as bottom trawls, disturbs the seafloor and reduces structural complexity. Indirect impacts of trawls include increased turbidity, alteration of surface sediment, removal of prey (leading to declines in predator abundance), removal of predators, ghost fishing (i.e., lost fishing gear continuing to ensnare fish and other marine animals), and generation of marine debris. Lost gill nets, purse seines, and long-lines may foul and disrupt bottom habitats.

Commercial fishing can have a profound influence on individual fish populations. In a study of retrospective data, Jackson et al. (2001) analyzed paleoecological records of marine sediments from 125,000 years ago to present, archaeological records from 10,000 years before the present, historical documents, and ecological records from scientific literature sources over the past century. Examining this longer-term data and information, Jackson et al. (2001) concluded that ecological extinction caused by overfishing precedes all other pervasive human disturbance of coastal ecosystems, including pollution and anthropogenic climatic change. 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).

4.3.7 MARITIME TRAFFIC

4.3.7.1 General

The east coast of the United States is heavily traveled by commercial, recreational, and government marine vessels, with several commercial ports near Navy OPAREAs. 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. The first container ships appeared in U.S. ports less than 50 years ago and are now the fastest-growing shipping segment. Container ship calls to U.S. Atlantic ports are expected to increase 4 percent per year through 2020, and vessel calls to U.S. Atlantic coast ports are forecast to rise from approximately 47,200 calls in 2000 to 93,500 calls in 2020 (Ward-Geiger et al. 2005). Sections 3.4.3.3.1 (Impact from Vessels) and 3.11.2.3 (Commercial Transportation and Shipping) provide additional information for marine vessel traffic in the Study Area. Primary concerns for the cumulative impacts analysis include vessels striking marine mammals and sea turtles and underwater sound from ships and other vessels.

4.3.7.2 Panama Canal Expansion

A project to widen and expand the capacity of the Panama Canal was started in 2007. Completion of the Panama Canal widening project in 2014 will double the Canal's tonnage volume by 2025 and allow larger vessels access to the east coast ports of the United States (Panama Canal Authority 2012).

4.3.7.3 Atlantic Coast Port Access Route Study

In May 2011, the U.S. Coast Guard announced that it will prepare the Atlantic Coast Port Access Route Study. The goal of the Atlantic Coast Port Access Route Study is to enhance navigational safety by examining existing shipping routes and waterway uses, and, to the extent practicable, reconcile the paramount right of navigation within designated port access routes with other reasonable waterway uses, such as the leasing of Outer Continental Shelf blocks for construction and operation of offshore renewable energy facilities. The Atlantic Coast Port Access Route Study will focus on the coastwise shipping routes and near coastal users between western Atlantic coastal ports, approaches to coastal ports, and future uses of those ports (including impacts of the widening of the Panama Canal) (U.S. Coast Guard 2011). An interim report was issued in July 2012 (U.S. Coast Guard 2012).

4.3.8 Development of Coastal Lands

Coastal land development adjacent to the Study Area is both intensive and extensive. Development continues to impact coastal resources through point and nonpoint source pollution, concentrated recreational use, and intensive ship traffic using major port facilities. The Study Area coastline also includes extensive coastal tourism development (e.g., hotels, resorts, restaurants, food industry, vacation homes, second homes) and the infrastructure supporting coastal development (e.g., retail businesses, marinas, fishing tackle stores, dive shops, fishing piers, recreational boating harbors, beaches, recreational fishing facilities).

Coastal development intensifies use of coastal resources, resulting in potential impacts on water quality, marine habitat, and air quality. Coastal development is regulated by states that border the Atlantic Ocean and Gulf of Mexico through the Coastal Zone Management Act and associated state and local programs. New development in the coastal zone requires a permit from the state or local government to which permitting authority has been delegated.

4.3.9 Ocean Noise

Ambient noise is the collection of ever-present sounds of both natural and human origin. Ambient noise in the ocean comprises sound generated by natural physical, natural biological, and anthropogenic (human-generated) sources (Figure 3.0-17). Pre-industrial physical and biological noise sources in marine environments were often not high enough to interfere with the hearing and communication of marine animals (Richardson et al. 1995); however, the increase in anthropogenic noise sources in recent times is a concern (Clark et al. 2009).

In addition to sounds generated during Navy training and testing, anthropogenic sound is introduced into the ocean by a number of sources, including vessel traffic, industrial operations onshore (pile driving), seismic profiling for oil exploration, oil drilling, and underwater explosions. Noise levels resulting from human activities in coastal and offshore areas are increasing; however, there are few historical records of ambient noise data to substantiate the level of increase.

Andrew et al. (2002) compared ocean ambient sound from the 1960s to the 1990s from a receiver off the California coast. The data showed an increase in ambient noise of approximately 10 dB in the frequency ranges of 20 to 80 hertz (Hz) and 200 to 300 Hz, and about 3 dB at 100 Hz over a 33-year period. A possible explanation for the rise in ambient noise is the increase in shipping noise. There are approximately 11,000 supertankers worldwide, each operating 300 days per year, producing constant broadband noise at source levels of 198 dB (Hildebrand 2004a). Within the Study Area, the east coast of the United States and the Gulf of Mexico are heavily traveled by marine vessels, with the highest concentrations of vessels occurring near several commercial ports (Figure 3.11-3). Hildebrand (2004b) found that the most energetic regularly operated sound sources are seismic airgun arrays from approximately 90 vessels with typically 12 to 48 individual guns per array, firing about every 10 seconds(Hildebrand 2004a). From 1968 through 2003, approximately 997,901 line mi. of two-dimensional seismic data were collected in the Gulf of Mexico region and 212,967 line mi. were collected in the Atlantic region (Minerals Management Service 2005a). The amount of seismic survey work conducted in the Atlantic region will likely increase in the near future (Sections 4.3.2.2 [Seismic Surveys] and 4.3.3 [Offshore Wind Energy]).

Section 3.0.4 (Acoustic and Explosives Primer) provides additional information about sources of anthropogenic sound in the ocean and other background information about underwater noise. Section 3.0.5.7.1 (Conceptual Framework for Assessing Effects from Sound-Producing Activities) describes the different types of effects that are possible and the potential relationships between sound stimuli and long-term consequences for individual animals and populations. A variety of impacts may result from exposure to sound-producing activities. The severity of these impacts can vary greatly between minor impacts that have no real cost to the animal to more severe impacts that may have lasting consequences. The major categories of potential impacts are behavioral reactions, physiological stress, auditory fatigue, auditory masking, and direct trauma.

4.3.10 Ocean Pollution

4.3.10.1 Overview

Pollution is the introduction of harmful contaminants that are outside the norm for a given ecosystem. Ocean pollution has and will continue to have serious impacts on marine ecosystems. Common ocean pollutants include toxic compounds such as metals, pesticides, and other organic chemicals; excess nutrients from fertilizers and sewage; detergents; oil; plastics; and other solids. Pollutants enter oceans from nonpoint sources (e.g., stormwater runoff from watersheds), point sources (e.g., wastewater treatment plant discharges), other land-based sources (e.g., windblown debris), spills, dumping, vessels, and atmospheric deposition.

4.3.10.2 Nonpoint Sources, Point Sources, and Atmospheric Deposition

Hypoxia (low dissolved oxygen concentration) is a major impact associated with point and nonpoint sources of pollution. Hypoxia occurs when waters become overloaded with nutrients such as nitrogen and phosphorus, which enter oceans from nonpoint source runoff, point sources, and atmospheric deposition. Too many nutrients can stimulate algal blooms—the rapid expansion of microscopic algae (phytoplankton). When excess nutrients are consumed, the algae population dies off and the remains are decomposed by bacteria. The bacteria use oxygen from the surrounding water during decomposition, which causes dissolved oxygen in the water to decline to the point where marine life that depend on oxygen can no longer survive (Boesch et al. 1997). The Gulf of Mexico has a seasonal hypoxic or dead zone that has averaged about 5,800 $mi.^2$ (roughly the size of Lake Ontario or New Jersey) over the past five years (Texas A&M University 2011).

Elevated nutrient loading has also been identified as a cause of harmful algal blooms. Harmful algal blooms are proliferations of marine and freshwater algae (including cyanobacteria and nonphotosynthetic algae-like organisms) that can produce toxins, causing human illness and massive animal mortalities. They also can accumulate in sufficient numbers to alter ecosystems in detrimental ways. These blooms are increasingly frequent in coastal waters around the world. Impacts include fish, bird, and marine mammal mortality (Anderson et al. 2002; Sellner et al. 2003). For example, in Florida, the deaths of 34 manatees in 2002 and 107 bottlenose dolphins in 2004 were linked to harmful algal blooms (Flewelling et al. 2005).

Nonpoint sources, point sources, and atmospheric deposition also contribute toxic pollutants such as metals, pesticides, and other organic compounds to the marine environment. Toxic pollutants may cause lethal or sublethal effects if present in high concentrations, and they can build up in tissues over time and suppress immune system function, resulting in disease and death.

4.3.10.3 Marine Debris

Marine debris is any anthropogenic object intentionally or unintentionally discarded, disposed of, or abandoned that enters the marine environment (National Marine Fisheries Service 2006). Approximately 80 percent of debris originates onshore and 20 percent from offshore sources. Common types of marine debris include various forms of plastic and abandoned fishing gear. Marine debris degrades marine habitat quality and poses ingestion and entanglement risks to marine life and birds (National Marine Fisheries Service 2006). Plastic debris is a major concern because it degrades slowly and many plastics float, allowing the debris to be transported by currents throughout the oceans.

Marine debris has been discovered to be accumulating in gyres throughout the oceans. Law et al. (2010) presented a time series of plastic content at the surface of the western North Atlantic Ocean and Caribbean Sea from 1986 to 2008. More than 60 percent of 6,136 surface plankton net tows collected small, buoyant plastic pieces. The data identified an accumulation zone east of Bermuda that is similar in size to the accumulation zone in the Pacific Ocean.

4.3.10.4 Major Pollution Events

Oil and other chemical spills have negative effects on many marine species. In April 2010, the *Deepwater Horizon* offshore drill rig, 41 mi. (66 km) southeast of the Louisiana coast, exploded and sank during exploratory well drilling, causing the largest accidental marine oil spill in U.S. history (National Commission on the BP *Deepwater Horizon* Oil Spill and Offshore Drilling 2011). The impacts of this disaster are just beginning to be studied, and it will likely be many years before impacts are understood. Impacts include those arising from direct exposure of marine life to oil and dispersants, habitat degradation, and disturbances caused by cleanup activities. A variety of indirect impacts such as changes in prey abundance and long-term disruption of other ecological processes could result from spills of this magnitude. Impacts of the *Deepwater Horizon* spill to specific resources are discussed in the Affected Environment sections of Chapter 3 (Affected Environment and Environmental Consequences).

The National Oceanic and Atmospheric Administration is managing restoration efforts in the aftermath of the spill and is preparing a Programmatic EIS to develop a framework for restoration. Considering the complexity and far-reaching potential impacts of the spill, it is important to conceptualize restoration at a broad scale to help identify how to best restore resources across the region. The emphasis of a Programmatic EIS is on developing a broad environmental program and a plan that would apply to future projects, the details and locations of which are yet unknown. The Programmatic EIS will also serve as the foundation for future analyses required by NEPA. The Notice of Intent to prepare the Programmatic EIS was published on 2 February 2011, and public release of the Draft Programmatic EIS is anticipated in 2013 (National Oceanic and Atmospheric Administration 2012). Restoration efforts could result in temporary adverse impacts, followed by long-term benefits.

4.3.11 CLIMATE CHANGE

Section 4.5 (Climate Change and Greenhouse Gas Emissions) provides background information and an analysis of the cumulative impacts of climate change and greenhouse gas emissions for the Proposed Action. Climate change is also considered in the overall cumulative impacts analysis as another environmental consideration. The Intergovernmental Panel on Climate Change (2007) reports that physical and biological systems on all continents and in most oceans are already being affected by recent climate changes. Global-scale assessment of observed changes shows that it is likely that anthropogenic warming over the last three decades has had a discernible influence on many physical and biological systems. Some of the major potential concerns for the marine environment include

- Sea temperature rise
- Melting of polar ice
- Rising sea levels
- Changes to major ocean current systems
- Ocean acidification

4.4 RESOURCE-SPECIFIC CUMULATIVE IMPACTS

4.4.1 SEDIMENTS AND WATER QUALITY

The analysis in Section 3.1 (Sediments and Water Quality) indicates that the alternatives could result in local, short- and long-term changes in sediment and water quality. However, 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 (Section 3.1.1.2, Methods, lists applicable standards, regulations, and guidelines). The short-term impacts could arise from explosions and the byproducts of explosions and combusted propellants. It is unlikely these short-term impacts would overlap in time and space with other future actions that produce similar constituents. For example, training and testing with explosives would not be expected to occur near an oil rig structure-removal operation that could use explosives. Therefore, the short-term impacts described in Section 3.1 (Sediments and Water Quality) are not expected to contribute to cumulative impacts.

The long-term impacts could arise from unexploded ordnance, noncombusted propellant, metals, and other materials. Long-term impacts of each alternative could be cumulative with other actions that cause increases in similar constituents. However, the incremental contribution of the No Action Alternative, Alternative 1, or Alternative 2 to long-term cumulative impacts would be negligible because

- Most training and testing activities are widely dispersed in space and time;
- Most components of expended materials are inert or corrode slowly;
- Numerically, most of the metals expended are small- and medium-caliber projectiles, metals of concern comprise a small portion of the alloys used in expended materials, and metal corrosion is a slow process that allows for dilution;
- Most of the components are subject to a variety of physical, chemical, and biological processes that render them benign; and
- Potential areas of impacts would be limited to small zones immediately adjacent to the explosive, metals, or chemicals other than explosives.

Furthermore, none of the alternatives would result in long-term and widespread changes in environmental conditions, such as nutrient loading, turbidity, salinity, or pH (a measure of the degree to which a solution is either acidic [pH less than 7.0] or basic [pH greater than 7.0]).

4.4.2 AIR QUALITY

As detailed in Section 3.2 (Air Quality), training and testing activities conducted under the alternatives would result in criteria pollutant emissions and hazardous air pollutant emissions throughout the Study Area. Emissions of these pollutants would increase under Alternative 1 or Alternative 2. Sources of the emissions would include vessels and aircraft and, to a lesser extent, munitions. Potential impacts include localized and temporarily elevated pollutant concentrations. Recovery would occur quickly as emissions disperse. The impacts of the No Action Alternative, Alternative 1, or Alternative 2 could be cumulative with other actions that involve criteria air pollutant and hazardous air pollutant emissions. However, the incremental contribution of each alternative to cumulative impacts would be low for the following reasons:

- Prevailing winds along the Atlantic coast generally trend west to east, reducing the likelihood that offshore emissions would impact air quality control regions ashore.
- Most of the proposed activities (approximately 70 percent) would occur at latitudes consistent with air quality control regions in attainment of the National Ambient Air Quality Standards for all criteria air pollutants.
- For those proposed activities occurring at latitudes consistent with air quality control region nonattainment or maintenance areas, most training and testing-related emissions (over 85 percent) are projected to occur at distances greater than 12 nm from shore.

Based on the analysis presented in Section 3.2 (Air Quality) and the reasons summarized above, the incremental contribution of the No Action Alternative, Alternative 1, or Alternative 2 to cumulative impacts would be negligible. An analysis of greenhouse gas emissions and climate change is provided in Section 4.5 (Climate Change and Greenhouse Gas Emissions).

4.4.3 Marine Habitats

The analysis presented in Section 3.3 (Marine Habitats) indicates that marine habitats could be affected by acoustic stressors (underwater detonations) and physical disturbance or strikes (interactions with 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. Impacts on soft bottom habitats would be short term, and impacts on hard bottom would be long term. The impacts of each alternative could be cumulative with other actions that cause similar disturbances. However, the incremental contribution of each alternative to cumulative impacts would be low for the following reasons:

- The area of hard bottom potentially impacted represents a negligible percentage of the total hard bottom habitat in the Study Area.
- Impacts would be confined to a limited area, and recovery of soft bottom habitats would occur quickly.

Based on the analysis presented in Section 3.3 (Marine Habitats) and the reasons summarized above, the incremental contribution of the No Action Alternative, Alternative 1, or Alternative 2 to cumulative impacts would be negligible.

4.4.4 Marine Mammals

4.4.4.1 Impacts of the Alternatives that Might Contribute to Cumulative Impacts

4.4.4.1.1 Overview

The analysis presented in Section 3.4 (Marine Mammals) concluded that some stressors associated with the No Action Alternative, Alternative 1, and Alternative 2 could impact individuals of certain marine mammal species, but impacts are not expected to decrease the overall fitness of any marine mammal population. From a cumulative perspective, potential impacts on ESA-listed species are of particular concern. In cases where potential impacts rise to the level that warrants mitigation, mitigation measures designed to reduce the potential impacts are discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring). Impacts of the alternatives that may contribute to cumulative impacts on marine mammals can be generally categorized as mortality, injury (Level A harassment under MMPA), and behavioral responses and temporary threshold shift (TTS) (Level B harassment under MMPA). As summarized below, these impacts would be associated with certain acoustic and physical strike stressors:

- The use of sonar, other active sources, and explosives may result in Level A harassment or Level B harassment of certain marine mammals (Tables 3.4-15 through 3.4-18 discuss sonar and other active acoustic sources, and Tables 3.4-26 through 3.4-33 discuss explosives). Explosives could also result in mortality of certain marine mammals. Sonar and other active acoustic sources may affect and are likely to adversely affect the ESA-listed North Atlantic right whale, humpback whale, sei whale, fin whale, blue whale, sperm whale, and West Indian manatee (Table 3.4-37). Explosives may affect and are likely to adversely affect the ESA-listed North Atlantic right whale (training activities only), sei whale, fin whale, and sperm whale (Table 3.4-37).
- Pile driving is not expected to result in mortality of any marine mammal species but may result in Level A and Level B harassment of bottlenose dolphins (Tables 3.4-34 and 3.4-35). Pile driving would have no effect or may affect, but it is not likely to adversely affect ESA-listed marine mammals (Table 3.4-37).
- The use of vessels is not expected to result in Level B harassment of any marine mammal species but may result in Level A harassment or mortality by vessel strikes in fin whale, humpback whale, minke whale, sei whale, Bryde's whale, sperm whale, blue whale, Blainville's beaked whale, Cuvier's beaked whale, Gervais' beaked whale, and unidentified whale species. Vessel strikes may affect and are likely to adversely affect the ESA-listed humpback whale, sei whale, fin whale, blue whale, and sperm whale. The Navy does not anticipate it will strike a North Atlantic right whale because of the extensive measures in place to reduce the risk of a strike to that species. The Navy does not anticipate it will strike a manatee as they only occur in a very limited portion of the Study Area, primarily in the coastal waters off the southeastern United States and the Gulf coast of Florida where vessel use is limited to only a few activities. The likelihood of a strike is very low around Jacksonville, Florida because of the low probability of vessel co-occurrence and the use of mitigation measures (Section 3.4.3.3, Physical Disturbance and Strike Stressors).

The remaining acoustic stressors (noise from airguns, weapons firing/launch/impact, aircraft, 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 parachutes), ingestion stressors (munitions and military expended materials other than munitions), and secondary stressors are not expected to result in Level A harassment, Level B harassment, or mortality of marine mammals under any of the alternatives. Furthermore, these stressors would have no effect or may affect but are not likely to adversely affect ESA-listed marine mammals (Table 3.4-37). For these reasons, the incremental contribution of these remaining stressors to cumulative impacts on marine mammals would be negligible. Therefore, these stressors are not considered further in the cumulative impacts analysis. The No Action Alternative, Alternative 1, and Alternative 2 would have no effect on North Atlantic right whale or West Indian manatee critical habitat. Therefore, marine mammal critical habitat is not considered further in the cumulative impacts analysis.

4.4.4.1.2 Level B Harassment

As presented in Tables 3.4-15 through 3.4-18 for sonar and other active acoustic sources and Tables 3.4-26 through 3.4-33 for explosives, the acoustic analysis predicts that most marine mammal species, including ESA-listed species, which occur in the Study Area would be exposed to underwater sound levels that could result in behavioral responses or TTS (Level B harassment). Individual animals exposed to underwater sound levels that represent Level B harassment may alert, ignore the stimulus, avoid the area by swimming away or diving, or display aggressive behavior. Long-term consequences for individuals or populations would not be expected. Animals that do experience TTS may have reduced ability to detect relevant sounds such as predators, prey, or social vocalizations until their hearing recovers. Recovery from a threshold shift (i.e., partial hearing loss) can take a few minutes to a few days depending on the severity of the initial shift. Threshold shifts do not necessarily affect all hearing frequencies equally, so some threshold shifts may not interfere with an animal's ability to hear biologically relevant sounds. Furthermore, mitigation measures discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) would further reduce the predicted impacts. Considering these factors and the low number of overall predicted impacts, long-term consequences for individuals or populations would not be expected.

4.4.4.1.3 Level A Harassment

As presented in Tables 3.4-15 through 3.4-18 for sonar and other active acoustic sources and Tables 3.4-26 through 3.4-33 for explosives, the acoustic analysis predicts that 30 marine mammal species could be exposed to underwater sound levels that could result injury or permanent threshold shift (PTS) (Level A harassment). Species most likely to be exposed to underwater sound levels that represent Level A harassment are those that are most abundant in the Study Area, primarily delphinid species (dolphins and small whales) that have stocks with tens of thousands of animals. ESA-listed marine mammals that could be exposed to underwater sound levels that represent Level A harassment include fin whale, humpback whale, sei whale, and sperm whale. Long-term consequences to populations would not be expected.

4.4.4.1.4 Mortality

Use of sonar and other active acoustic sources under the No Action Alternative, Alternative 1, and Alternative 2 is not expected to result in marine mammal mortality. Mitigation measures discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) 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 sound pressure levels from explosive detonations that represent onset mortality (Tables 3.4-26 through 3.4-33). The protections afforded by mitigation measures cannot be fully quantified. Therefore, mortality from explosions could occur in isolated instances.

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 sound pressure levels from explosive detonations that represent onset mortality (Tables 3.4-22 through 3.4-29). Potentially lethal impacts were not predicted for other ESA-listed marine mammals.

Aircraft carrier ship shock trials occurring once per five-year period and guided missile destroyer/littoral combat 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 either the Virginia Capes OPAREA or the Jacksonville OPAREA in waters deeper than 650 ft. Specific mitigation measures discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) 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. Based on conservativeness of the onset mortality criteria and impulse modeling, and past observations of no marine mammal mortalities associated with ship shock trials, the mortalities predicted for the aircraft carrier ship shock trial are considered overestimates and highly unlikely to occur. Therefore, the Navy conservatively estimates that 10 small odontocete mortalities could occur during the aircraft carrier ship shock trial. Measureable long-term consequences to populations are unlikely.

Vessel strikes could also result in mortality of certain marine mammal species under the No Action Alternative, Alternative 1, and Alternative 2. Based on historical records and the analysis presented in Section 3.4.3.3 (Physical Disturbance and Strike Stressors), the Navy estimates it may strike and take, by injury or mortality, an average of two marine mammals per year, with a maximum of three in any given year. While the species involved in a strike cannot be quantifiably predicted, the affected animals could be a combination of the following species: fin whale, humpback whale, minke whale, sei whale, Bryde's whale, sperm whale, blue whale, Blainville's beaked whale, Cuvier's beaked whale, Gervais' beaked whale, and unidentified whale species. Of the ESA-listed species in the Study Area, the Navy anticipates no more than three humpback whales, two fin whales, one sei whale, one blue whale, and one sperm whale could be struck over a five-year period based on the percentages that those species have been involved in vessel collisions. The Navy does not anticipate it would strike a North Atlantic right whale or West Indian manatee.

4.4.4.2 Impacts of Other Actions

4.4.4.2.1 Overview

Potential impacts of other actions relevant to the cumulative impacts analysis for marine mammals include the following:

- Mortality associated with vessel strikes, bycatch in fisheries, and entanglement in fishing and other gear.
- Injury associated with vessel strikes, bycatch, entanglement, and underwater sound.
- Disturbance, behavioral modifications, and reduced animal fitness associated with underwater noise.
- Reduced animal fitness associated with water pollution.

Most of the other actions and considerations retained for analysis in Table 4.3-1 include the operation of marine vessels. Stressors associated with marine vessel operations that are of primary concern for the cumulative impacts analysis include vessel strikes and underwater noise. Many of the actions could also result in underwater noise from sources other than vessels, including use of explosives for oil rig removal, seismic surveys, and construction activities. Rather than discussing these stressors for individual actions, their aggregate impacts are considered below as "other environmental considerations" in the maritime traffic and ocean noise subsections. Similarly, many of the actions could result in water pollution. The aggregate impacts of water pollution are addressed below in the ocean pollution section. Bycatch and entanglement are associated with commercial fishing; therefore, these stressors are discussed below in the commercial fishing section.

4.4.4.2.2 Surveillance Towed Array Sensor System Low Frequency Active Sonar

Potential impacts on marine mammals from Surveillance Towed Array Sensor System Low Frequency Active Sonar operations include (1) nonauditory injury; (2) permanent loss of hearing; (3) temporary loss of hearing; (4) behavioral change; and (5) masking. The potential effects from Surveillance Towed Array Sensor System Low Frequency Active Sonar operations on any stock of marine mammals from injury (nonauditory or permanent loss of hearing) are considered negligible, and the potential effects on the stock of any marine mammal from temporary loss of hearing or behavioral change (significant change in a biologically important behavior) are considered minimal. Any auditory masking in marine mammals due to low-frequency active sonar signal transmissions is not expected to be severe and would be temporary. The operation of Surveillance Towed Array Sensor System Low Frequency Active Sonar with monitoring and mitigation would result in no mortality. The likelihood of low-frequency active sonar transmissions causing marine mammals to strand is negligible (U.S. Department of the Navy 2011).

4.4.4.2.3 Maritime Traffic and Vessel Strikes

As discussed in Section 4.3.7 (Maritime Traffic), maritime traffic has increased over the past 50 years, and continued increases are expected in the future. Vessel strikes are, and will continue to be, a cause of marine mammal mortality and injury throughout the Study Area. A review of the impacts of vessel strikes on marine mammals is in Section 3.4.3.3.1 (Impact from Vessels). 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 and Shaw 2006; Nowacek et al. 2003). Marine mammals such as dolphins, porpoises, and pinnipeds that can move quickly throughout the water column are not as susceptible to vessel strikes. Most vessel strikes of marine mammals reported involve commercial vessels and occur over or near the continental shelf (Laist et al. 2001). National Marine Fisheries Service records for the Study Area (unpublished data 1995–2011) indicate the following percentage of strikes by species: North Atlantic right whale (19 percent), humpback whale (28 percent), minke whale (5 percent), Bryde’s whale (2 percent), sei whale (6 percent), fin whale (17 percent), sperm whale (2 percent), Cuvier’s beaked whale (3 percent), Blainville’s beaked whale (1 percent), Gervais’ beaked whale (1 percent), and unknown species (16 percent). West Indian manatees are also highly susceptible to boat strikes, but the data were not readily available to calculate a comparable percentage. The literature review by Laist et al. (2001) concluded that vessel strikes likely have a negligible impact on the status of most whale populations, but that for small populations, such as the North Atlantic right whale, vessel strikes may have considerable population-level impacts. The abundance of the species struck would in large part determine whether the injury would have population-level impacts on that species (Laist et al. 2001). Vessel strike data for selected marine mammal stocks for 2004-2008 are provided in Table 4.4-1.

4.4.4.2.4 Ocean Noise

As summarized by the National Academies of Science, the possibility that anthropogenic sound could harm marine mammals or significantly interfere with their normal activities is an issue of concern (National Research Council 2005). Noise is of particular concern to marine mammals because many species use sound as a primary sense for navigating, finding prey, and communicating with other individuals. Noise can cause behavioral disturbances, mask other sounds (including their own vocalizations), result in injury, and in some cases, even lead to death (Tyack 2009; Würsig and Richardson 2008). Human-caused noises in the marine environment come from shipping, seismic and geologic exploration, military training, and other types of pulses produced by government, commercial, industry, and private sources. In addition, noise from whale-watching vessels near marine mammals has received a great deal of attention (Wartzok 2009).

Table 4.4-1: 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 Adjacent Canadian Maritimes, 2004–2008, with Number of Events Attributed to Entanglements or Vessel Collisions by Year

Stock	Mean Annual Mortality and Serious Injury Rate	Entanglements			Vessel Collisions		
		Annual Rate (U.S. Waters/Canadian Waters)	Confirmed Mortalities (2004, 2005, 2006, 2007, 2008)	Confirmed Serious Injuries (2004, 2005, 2006, 2007, 2008)	Annual Rate (U.S. Waters/ Canadian Waters)	Confirmed Mortalities (2004, 2005, 2006, 2007, 2008)	Confirmed Serious Injuries (2004, 2005, 2006, 2007, 2008)
Western North Atlantic Right Whale	2.8	0.8 (0.6/0.2)	(1, 0, 1, 1, 0)	(0, 0, 0, 0, 1)	2.0 (1.6/0.4)	(2, 2, 4, 0, 0)	(0, 1, 1, 0, 0)
Gulf of Maine Humpback Whale[1]	4.6	3.0 (2.6/0.4)	(1, 0, 1, 1, 2)	(1, 0, 3, 2, 4)	1.6 (1.6/0)	(1, 0, 3, 3, 1)	0
Western North Atlantic Fin Whale	3.2	1.2 (1.0/0.2)	(1, 0, 0, 2, 0)	(1, 0, 1, 1, 0)	2.0 (1.4/0.6)	(2, 5, 0, 2, 1)	0
Nova Scotian Sei Whale	1.0	0.6 (0.4/0.2)	(0, 0, 0, 0, 1)	(0, 0, 1, 0, 1)	0.4 (0.4/0)	(0, 0, 1, 1, 0)	0
Western North Atlantic Blue Whale	0	0	0	0	0	0	0
Canadian East Coast Minke Whale[2]	3.2	2.8 (1.6/1.2)	(4, 1, 1, 1, 6)	(0, 0, 0, 1, 0)	0.4 (0.4/0)	(1, 1, 0, 0, 0)	0
Western North Atlantic Bryde's Whale	0	0	0	0	0	0	0

Source: Waring et al. 2011

[1] Excludes events involving confirmed members of a stock other than the Gulf of Maine feeding stock.

[2] Includes three records from the Northeast Fisheries Observer Program.

Assessing whether a sound may disturb or injure a marine mammal involves understanding the characteristics of the acoustic sources, the marine mammals that may be present near the sound, and the effects that sound may have on the physiology and behavior of those marine mammals. Although it is known that sound is important for marine mammal communication, navigation, and foraging (National Research Council 2003, 2005), there are many unknowns in assessing the specific effects and significance of responses by marine mammals to sound exposures such as what activity the animal is engaged in at the time of the exposure (Nowacek et al. 2007; Southall et al. 2007). Potential impacts on marine mammals from ocean noise include behavioral reactions, hearing loss in the form of TTS or PTS, auditory masking, injury, and mortality. Section 3.4.3.1 (Acoustic Stressors) discusses these and other possible impacts of ocean noise on marine mammals.

4.4.4.2.5 Ocean Pollution

As discussed in Section 4.3.10 (Ocean Pollution), multiple pollutants from multiple sources are present in, and continue to be released into, the oceans. Long-term exposure to pollutants poses potential risks to the health of marine mammals, although for the most part, the impacts are just starting to be understood (Reijnders et al. 2008). Concern about the possible effects of exposure to pollutants has increased in recent years because disease outbreaks involving marine mammals with high concentrations of organochlorines in tissues appear to have occurred with increasing frequency. 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). Section 3.4.2.4 (General Threats to Marine Mammals) provides an overview of these potential impacts, which include morbidity and mortality from acute toxicity (although mortality has not yet specifically been shown in marine mammals); 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 (Reijnders et al. 2008).

If the health of an individual marine mammal were compromised by long-term exposure to pollutants, it is possible this condition could alter the animal’s expected response to stressors associated with the alternatives. 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 2005). While the response of a previously stressed animal might be different from the response of an unstressed animal, no data available at this time accurately predict how stress caused by various ocean pollutants would alter a marine mammal’s response to stressors associated with the No Action Alternative, Alternative 1, or Alternative 2.

4.4.4.2.6 Commercial Fishing

Several commercial fisheries operate in the Study Area. Potential impacts from these activities include marine mammal injury and mortality from bycatch and entanglement. The operations of fisheries also results in profound changes to the structure and function of marine ecosystems that adversely affect marine mammals.

Between 1990 and 1999, the annual bycatch of marine mammals in the United States was more than 6,000 animals, and most of these were killed in gill-net fisheries (Read et al. 2006). 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 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.

As discussed in Section 3.4.2.4 (General Threats), entanglement in fishing gear is another major threat to marine mammals in the Study Area, including North Atlantic right and humpback whales. Entanglement records from 1990 through 2009 maintained by the NMFS Northeast Regional Office included 85 confirmed right whale entanglements, including right whales in weirs, gillnets, and trailing line and buoys (National Marine Fisheries Service 2011). Of 20 dead humpback whales (principally in the mid-Atlantic, where decomposition did not preclude examination for human impacts), Wiley et al. (1995) reported that five (25 percent) had injuries consistent with possible entanglement in fishing gear.

The number of North Atlantic right whales killed or injured annually by ship strikes (all vessel types) and in entanglements has increased slightly since 1999. From 1999 to 2003, an average of 2.6 right whales were killed per year; from 2000 to 2004, an average of 2.8 right whales were killed per year; from 2001 to 2005, an average of 3.2 right whales were killed per year (Waring et al. 2010). The most recent estimate of anthropogenic mortality and serious injury available shows a rate of 3.8 right whales per year from 2002 to 2006. Of these, 2.4 were attributed to ship strikes and 1.4 were attributed to entanglements (Glass et al. 2008). Of the current threats to North Atlantic right whales, entanglement in commercial fishing gear and ship strikes currently pose the greatest threats (National Oceanic and Atmospheric Administration 2010). These threats are expected to continue into the foreseeable future.

In addition, 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 and Worm 2003; Pauly et al. 1998). 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.

In summary, future commercial fishing activities in the Study Area are expected to result in significant impacts on some marine mammal species based on the injury and mortality rates associated with bycatch and entanglement. This mortality could result in or contribute to population declines for some species, including ESA-listed species such as the North Atlantic right whale. Ecological changes brought about by commercial fishing are also expected to adversely impact marine mammals in the Study Area.

4.4.4.2.7 Environmental Regulation and Planning

As of March 2013, NMFS was continuing the rulemaking process for designating additional critical habitat for the North Atlantic right whale. Eventual publication of a final rule designating additional critical habitat is reasonably foreseeable, but a specific timeline was not available as of March 2013. Federal agencies would be required to ensure that actions they fund, authorize, or carry out are not likely to result in the destruction or adverse modification of critical habitat. This future action is expected to benefit the North Atlantic right whale by reducing impacts on habitat important to the survival of this species. However, this action is not expected to reduce primary threats of vessel strikes and entanglement. The overall benefits of this action to the species are uncertain at this time.

4.4.4.3 Cumulative Impacts on Marine Mammals

Of the 48 species of marine mammals known to exist within the Study Area, 10 are listed as endangered under ESA and classified as strategic stocks under MMPA (North Atlantic right whale, bowhead whale, humpback whale, minke whale, Bryde's whale, sei whale, fin whale, blue whale, sperm whale, and West Indian manatee), one is listed as threatened under ESA (polar bear), and one is proposed for listing under ESA (Arctic subspecies of ringed seal). In addition, the pygmy sperm whale and some bottlenose dolphin stocks are classified as strategic stocks. These ESA listings and MMPA classifications provide a clear indication that the current aggregate impacts of past human activities are significant for some marine mammal species in the Study Area. Many of the past activities such as commercial fishing that have current impacts are also present actions and reasonably foreseeable future actions.

Direct, human-caused mortality of marine mammals is one of the primary issues of concern for this cumulative impacts analysis. Bycatch, vessel strikes, and entanglement are leading causes of direct mortality to marine mammals and will continue to cause mortality in the future. Read et al. (2006) noted that marine mammal bycatch declined from 1990 to 1999 after the implementation of take reduction measures in the latter half of the decade. While new management practices could result in future reductions, bycatch is expected to remain a leading cause of mortality for the reasonably foreseeable future. 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.

Each alternative could also result in injury and mortality to individuals of some marine mammal species from underwater explosions and vessel strikes. Implementation of measures discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) would reduce but not eliminate potential impacts. Injury and mortality that might occur under the No Action Alternative, Alternative 1, or Alternative 2 could be additive to injury and mortality associated with other actions, but the relative contribution would be low. Each alternative has the potential for a few mortalities per year, compared to more than 1,000 per year for other actions. For example, the mean annual bycatch of marine mammals in U.S. fisheries between 1990 and 1999 was 6,215, consisting of 3,029 cetaceans and 3,187 pinnipeds (Read et al. 2006). A substantial proportion of these mortalities likely occurred in the Study Area or affected individuals that used the Study Area seasonally. The estimated mean annual bycatch mortality of western North Atlantic cetaceans in U.S. observed fisheries for 2004–2008 was about 1,500 (Waring et al. 2010). Table 4.4-2 provides a general comparison of estimated cetacean mortalities and serious injuries from various causes.

Ocean noise associated with other actions (Section 4.4.4.2.4, Ocean Noise) and acoustic stressors (underwater explosions and sonar) associated with each alternative could also result in additive impacts on marine mammals. Other future actions such as construction and operation of liquefied natural gas terminals, construction of the Cape Wind Energy project, seismic surveys, wind energy site characterization, and construction and removal of oil and gas facilities, could result in underwater sound levels that could cause MMPA Level B harassment and, to a lesser extent, Level A harassment or mortality. With the possible exception of other actions that involve the use of explosives, the potential for direct marine mammal mortality from other actions is very low. 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 sonar use. However, these activities are widely dispersed, the sound sources are intermittent, and mitigation measures are often required under MMPA to minimize exposure. For these reasons it is unlikely that an individual would be simultaneously exposed to sound levels from multiple actions that could cause Level B harassment or Level A harassment. 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 exposure.

Table 4.4-2: Comparison of Cetacean Mortality from Various Activities

Activity	Approximate Mortalities and Serious Injuries	References
Commercial Fishing Bycatch: Worldwide	308,000 annual mortalities and serious injuries	Read et al. (2006)
"Scientific Research"/Commercial Harvest: Japan and Iceland	1,500 mortalities per year	International Whaling Commission (2008)
Commercial Fishing Bycatch: U.S. Observed Fisheries	1,500 mean annual mortalities of western North Atlantic cetaceans for 2004–2008	Waring et al. (2011)
Entanglements: Gulf of Mexico Coast, U.S. East Coast, and Adjacent Canadian Maritimes	8.4 mean annual mortalities and serious injuries of baleen whales for 2004–2008	Waring et al. (2011)
Ship Strikes: Gulf of Mexico Coast, U.S. East Coast, And Adjacent Canadian Maritimes	6.4 mean annual mortalities and serious injuries of baleen whales for 2004–2008	Waring et al. (2011)
U.S. Navy Sonar: Worldwide	40 total known, scientifically verifiable mortalities among cetaceans, consisting mostly of beaked whales	International Council for the Exploration of the Sea (2005a, b)

It is likely that distant shipping noise (which is more widespread and continuous) and sound associated with underwater explosions and sonar would overlap in time and space. 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, as the International Council for the Exploration of the Sea (2005a) noted, taken in context of marine mammal populations in general, sonar is neither a major threat nor a significant portion of the overall ocean noise budget. This has also been demonstrated by monitoring in areas where the Navy operates (Bassett et al. 2010; Baumann-Pickering et al. 2010; McDonald et al. 2006).

As discussed in Section 4.4.4.2.2 (Ocean Pollution), the potential also exists for the impacts of ocean pollution and acoustic stressors associated with each alternative to be additive or synergistic. It is possible that the response of a previously stressed animal would be more severe than the response of an unstressed animal. However, no data indicate that a marine mammal affected by ocean pollution would be more susceptible to stressors associated with the No Action Alternative, Alternative 1, or Alternative 2.

In summary, the aggregate impacts of past, present, and other reasonably foreseeable future actions are expected to result in significant impacts on some marine mammal species in the Study Area. The No Action Alternative, Alternative 1, or Alternative 2 could contribute to cumulative impacts, but the relative contribution would be low compared to other actions. In comparison to potential mortality, strandings, or injury resulting from Navy training and testing activities, marine mammal mortality and injury from bycatch, commercial vessel ship strikes, entanglement, and ocean pollution are estimated to be orders of magnitude greater (hundreds of thousands of animals versus tens of animals) (Culik 2004; International Council for the Exploration of the Sea 2005b; Read et al. 2006).

4.4.5 SEA TURTLES AND OTHER MARINE REPTILES

4.4.5.1 Impacts of the Alternatives That Might Contribute to Cumulative Impacts

Impacts of the alternatives on the American crocodile and American alligator would be negligible. Therefore, the cumulative impacts analysis is limited to green, hawksbill, Kemp's ridley, leatherback, and loggerhead turtles, all of which are ESA-listed. The analysis presented in Section 3.5 (Sea Turtles and Other Marine Reptiles) concludes that some stressors associated with the No Action Alternative, Alternative 1, and Alternative 2 could impact individuals of certain sea turtle species, but impacts are not expected to decrease the overall fitness of any sea turtle populations. From a cumulative perspective, potential impacts on ESA-listed species are of particular concern. In cases where potential impacts rise to the level that warrants mitigation, mitigation measures designed to reduce the potential impacts are discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring). Impacts of the alternatives 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 other active sources may result in behavioral responses, TTS, and PTS in sea turtles (Tables 3.5-6 through 3.5-8). Sonar and other activities' acoustic sources may affect and are likely to adversely affect ESA-listed sea turtles (Table 3.5-18).
- Explosives may result in behavioral responses, TTS, PTS, injury, and mortality in sea turtles (Tables 3.5-10 through 3.5-16). Explosives may affect and are likely to adversely affect ESA-listed sea turtles (Table 3.5-18).
- Vessel strikes may cause injury or mortality in sea turtles. Vessel strikes may affect and are likely to adversely affect ESA-listed sea turtles (Section 3.5.3.3.1, Impacts from Vessels).

The remaining acoustic stressors (noise from airguns, weapons firing/launch/impact, aircraft, 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 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 any of the alternatives. Furthermore, these stressors would have no effect or may affect but are not likely to adversely affect ESA-listed sea turtles (Table 3.5-18). For these reasons, the incremental contribution of these remaining stressors to cumulative impacts on sea turtles would be negligible. Therefore, these stressors are not considered further in the cumulative impacts analysis.

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 impact 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 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. 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 widely spaced, allowing exposed individuals to recover. Since long-term consequences for most individuals are unlikely, long-term consequences for populations are not expected.

4.4.5.2 Impacts of Other Actions

4.4.5.2.1 Overview

The potential impacts of other actions relevant to the cumulative impacts analysis for sea turtles include the following:

- Mortality associated with vessel strikes, bycatch in fisheries, entanglement, ingestion of marine debris, illegal harvest, and stressors associated with coastal development and human use of coastal environments (e.g., beach vehicular driving, power plant entrainment, etc.)
- Injury associated with vessel strikes, bycatch, entanglement, ingestion of marine debris, and underwater sound
- Disturbance, behavioral modifications, and reduced animal fitness associated with underwater noise
- Reduced animal fitness associated with prey and habitat degradation caused by water pollution or other causes
- Habitat loss related to coastal development

Most other actions and considerations retained for analysis in Table 4.3-1 include operation of marine vessels. Stressors associated with marine vessel operations that are of primary concern for the cumulative impacts analysis include vessel strikes and underwater noise. Many of the actions could also result in underwater noise from sources other than vessels, including use of explosives for oil rig removal, seismic surveys, and construction activities. Rather than discussing these stressors for individual actions, their aggregate impacts are considered below as "other environmental considerations" in Sections 4.4.5.2.3 (Maritime Traffic and Vessel Strikes) and 4.4.5.2.4 (Ocean Noise). Similarly, many of the actions could result in water pollution. The aggregate impacts of water pollution are addressed in Section 4.4.4.2.5 (Ocean Pollution). Bycatch and entanglement are associated with commercial fishing, discussed in Section 4.4.5.2.6 (Commercial Fishing).

4.4.5.2.2 Surveillance Towed Array Sensor System Low Frequency Active Sonar

Sea turtles could be affected if they are inside the mitigation zone (180-dB sound field) during a Surveillance Towed Array Sensor System Low Frequency Active Sonar transmission. However, because received levels from Surveillance Towed Array Sensor System Low Frequency Active Sonar operations would be below 180 dB re 1 µPa (root mean square) sound pressure level within 12 nm or greater distance of any coastlines and offshore biologically important areas, effects on a sea turtle stock could occur only if a significant portion of the stock encountered the Surveillance Towed Array Sensor System Low Frequency Active Sonar vessel in the open ocean. The potential for Surveillance Towed Array Sensor System Low Frequency Active Sonar operations to expose sea turtle stocks to injurious (nonauditory or PTS) sound levels or to cause TTS or behavioral changes is considered negligible because (U.S. Department of the Navy 2011):

- Most sea turtle species inhabit the earth's oceanic temperate zones, where sound propagation is predominantly characterized by downward refraction (higher transmission loss, shorter range), rather than ducting (lower transmission loss, longer range), which is usually found in cold-water regimes.
- Sea turtle distribution and density are generally low at ranges greater than 12 nm from the coast.
- The Surveillance Towed Array Sensor System Low Frequency Active Sonar signal has a narrow bandwidth (approximately 30 Hz).

- The ship is always moving, and the system has a low duty cycle (estimated 7.5 percent), which means sea turtles would have less opportunity to be in the mitigation zone during a transmission.
- Visual monitoring mitigation is incorporated into the alternatives.

4.4.5.2.3 Maritime Traffic and Vessel Strikes

As discussed in Section 4.3.7 (Maritime Traffic), maritime traffic has increased over the past 50 years, and continued increases are expected in the future. For example, container ship calls to U.S. Atlantic ports are expected to increase 4 percent per year through 2020 (Ward-Geiger et al. 2005). Vessel strikes have been and will continue to be a cause of sea turtle mortality and injury throughout portions of the Study Area where sea turtles regularly occur.

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. Much of what is written about recovery from vessel strikes is inferred from observing individuals a period of time after a strike. 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. Conversely, 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. A National Research Council report qualitatively ranked the relative importance of various mortality factors for sea turtles. Vessel strikes were ranked 10th, behind leading factors of shrimp trawling and other fisheries (National Research Council 1990).

4.4.5.2.4 Ocean Noise

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 and Ketten 2006; Bartol and Musick 2003; Ketten and 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 and Lohmann 1992; Lohmann and Lohmann 1996) and light (Avens and Lohmann 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 3.5.3.1 (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.

4.4.5.2.5 Ocean Pollution

Oil and gas exploration and development in the Gulf of Mexico are a particular threat to Kemp's ridley turtles because most of the population occurs there. Kemp's ridley turtles covered in crude oil have been documented to strand on beaches in Mexico, and most of the turtles found injured and dead following the *Deepwater Horizon* oil spill were Kemp's ridley turtles (National Marine Fisheries Service 2010, 2011).

Marine debris can also be a problem for sea turtles through entanglement or ingestion. Sea turtles can 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.

4.4.5.2.6 Commercial Fishing

Bycatch is one of the most serious threats to the recovery and conservation of marine turtle populations (National Research Council 1990; Wallace et al. 2010). Among fisheries that incidentally capture sea turtles, certain types of trawl, gillnet, and longline fisheries generally pose the greatest threat. One comprehensive study estimated that worldwide, 447,000 turtles are killed each year from bycatch in commercial fisheries (Wallace et al. 2010). The Biological Opinion issued by NMFS in June 2009 for Navy range complexes along the Atlantic coast provided the following estimates of sea turtle bycatch for shrimp trawl fisheries (National Marine Fisheries Service 2009):

> The fisheries that have the most significant demographic effect on sea turtles are the shrimp trawl fisheries conducted off the southeast United States (from North Carolina to the Atlantic coast of Florida) and Gulf of Mexico (from the Gulf coast of Florida to Texas). Although participants in these fisheries are required to use Turtle Exclusion Devices, which are estimated to reduce the number of sea turtles trawlers capture by as much as 97 percent, each year these fisheries are expected to capture about 185,000 sea turtles and kill about 5,000 of the turtles captured. Loggerhead sea turtles account for most of this total: each of these fisheries is expected to capture about 163,000 loggerhead sea turtles, killing almost 4,000 of them. These are followed by green sea turtles: about 18,700 green sea turtles are expected to be captured each year with more than 500 of them dying as a result of their capture.

Other 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 2009).

4.4.5.2.7 Coastal Land Development

Coastal land development and increased human populations in coastal areas will continue to have impacts on sea turtles due to nesting beach habitat degradation, beach vehicular driving, beach lighting, power plant entrainment, habitat alteration from nearshore dredging and beach nourishment, and degradation of nearshore water quality and seagrass beds.

4.4.5.3 Cumulative Impacts on Sea Turtles and Other Marine 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.

Many of the past activities such as commercial fishing that have current impacts are also present actions and reasonably foreseeable future actions.

Direct, human-caused mortality of sea turtles is one of the primary issues of concern for this cumulative impacts analysis. Bycatch, vessel strikes, entanglement, ingestion, and nest destruction are human causes of direct mortality to sea turtles and will continue to cause mortality in the future. While new management practices could result in future reductions, bycatch is expected to remain a leading cause of mortality for the reasonably foreseeable future. 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, the risks of vessel strikes can be minimized by ongoing and future education and awareness, ship speed reduction measures (primarily aimed at protecting marine mammals), and maritime traffic planning and management.

Each alternative could also result in injury and mortality to individual sea turtles from underwater explosions and vessel strikes. Implementation of measures discussed in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring) would reduce but not eliminate potential impacts. Injury and mortality that might occur under the No Action Alternative, Alternative 1, or Alternative 2 could be additive to injury and mortality associated with other actions, but the relative contribution would be low. Each alternative has the potential for a few mortalities per year, compared to about 5,000 sea turtle mortalities per year in the shrimp trawl fishery alone (National Marine Fisheries Service 2009) and more than 1,000 per year for other actions.

Ocean noise associated with other actions (Section 4.4.4.2.4, Ocean Noise) and acoustic stressors (underwater explosions and sonar) associated with each alternative could also result in additive behavioral impacts on sea turtles. Other future actions such as construction and operation of liquefied natural gas terminals, construction of the Cape Wind Energy project, seismic surveys, and construction and removal of oil and gas facilities would be expected to result in similar impacts. However, it is unlikely these actions and underwater explosions or sonar use would overlap in time and space because all these activities are widespread and the sound sources are intermittent. Furthermore, safety, security, and operational considerations would preclude some training and testing activities in the immediate vicinity of other actions.

It is likely that distant shipping noise (which is more widespread and continuous) and sound associated with underwater explosions and sonar would overlap in time and space. However, there is no evidence indicating that the co-occurrence of shipping noise and sounds associated with underwater explosions and sonar use would result in harmful additive impacts on sea turtles.

As discussed in Section 4.4.4.2.2 (Ocean Pollution), the potential also exists for the impacts of ocean pollution and acoustic stressors associated with each alternative to be additive or synergistic. It is possible that the response of a previously stressed animal could be more severe than the response of an unstressed animal. However, there are no data indicating that a sea turtle affected by ocean pollution would be more susceptible to stressors associated with the No Action Alternative, Alternative 1, or Alternative 2.

In summary, the aggregate impacts of past, present, and other actions and reasonably foreseeable future actions are expected to result in significant impacts on green, hawksbill, Kemp's ridley, leatherback, and loggerhead turtles. The No Action Alternative, Alternative 1, or Alternative 2 could contribute to cumulative impacts, but the relative contribution would be low compared to other actions such as commercial fishing.

4.4.6 Birds

The analysis in Section 3.6 (Birds) indicates that birds could potentially be impacted by acoustic stressors (tactical acoustic sonar, other acoustic devices, pile driving, underwater explosions, weapons firing noise, aircraft noise, vessel noise), energy stressors (electromagnetic, lasers), physical disturbance and strikes (aircraft, aerial targets, vessels and in-water devices, military expended materials), and ingestion (military expended materials). Potential responses could include a startle response, which includes short-term behavioral (e.g., movement) and physiological components (e.g., increased heart rate). Recovery from the impacts of most stressor exposures would occur quickly, and impacts would be localized. Some stressors, including underwater explosions, physical strikes, and ingestion of plastic military expended materials, could result in mortality. However, the number of individual birds affected is expected to be low, and no population-level impacts are expected. The impacts of each alternative could be cumulative with other actions that cause short-term behavioral and physiological impacts and mortality to birds. However, the incremental contribution of the No Action Alternative, Alternative 1, or Alternative 2 to cumulative impacts on birds would be low for the following reasons:

- Most of the proposed activities would be widely dispersed in offshore areas, where bird distribution is patchy and concentrations of individuals are often low. Therefore, the potential for interactions between birds and training and testing activities is low.
- 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. None of the alternatives would result in destruction or loss of nesting habitat.
- For most stressors, impacts would be short term and localized, and recovery would occur quickly.
- While a limited amount of mortality could occur, no population-level impacts would be expected.
- None of the alternatives are likely to adversely affect ESA-listed bird species.

Based on the analysis in Section 3.6 (Birds), and the reasons summarized above, the incremental contribution of the No Action Alternative, Alternative 1, or Alternative 2 to cumulative impacts would be negligible.

4.4.7 Marine Vegetation

The analysis presented in Section 3.7 (Marine Vegetation) indicates that marine vegetation could be affected by acoustic stressors (underwater explosions) and physical stressors (interactions with vessels and in-water devices, military expended materials, or seafloor devices). Potential impacts include localized disturbance and mortality. Recovery would occur quickly, and population-level impacts are not anticipated. The impacts of each alternative could be cumulative with other actions that cause disturbance and mortality of marine vegetation. However, the incremental contribution of the No Action Alternative, Alternative 1, or Alternative 2 to cumulative impacts would be low for the following reasons:

- Most of the proposed activities would occur in areas where seagrasses and other attached marine vegetation do not grow.

- Impacts would be localized, recovery would occur quickly, and no population-level impacts would be expected.
- None of the alternatives would result in impacts that have been historically significant to marine vegetation. For example, the alternatives would not increase nutrient loading, which can cause algal blooms, decrease light penetration, and impact photosynthesis of seagrasses.
- 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 vegetation.
- The Proposed Action would have no effect on ESA-listed species of marine vegetation and would not result in the destruction or adverse modification of critical habitat.

Based on the analysis presented in Section 3.7 (Marine Vegetation) and the reasons summarized above, the incremental contribution of the No Action Alternative, Alternative 1, or Alternative 2 to cumulative impacts would be low.

4.4.8 Marine Invertebrates

The analysis presented in Section 3.8 (Marine Invertebrates) indicates that marine invertebrates could be affected by acoustic stressors (tactical acoustic sonar, other acoustic devices, pile driving, underwater explosions, weapons firing noise, aircraft noise, vessel noise), electromagnetic stressors, physical disturbance or strikes (vessels and in-water devices, military expended materials, seafloor devices), entanglement (cables and wires, parachutes), and ingestion (military expended materials). Potential impacts include short-term behavioral and physiological responses. Some stressors could also result in injury or mortality to a relatively small number of individuals but not to ESA-listed corals. No population-level impacts are anticipated. The No Action Alternative, Alternative 1, or Alternative 2 would have no effect on ESA-listed corals or may affect but not likely to adversely affect ESA-listed corals. The invertebrate mortality impacts of each alternative could be cumulative with other actions that cause mortality (e.g., commercial fishing). However, the incremental contribution of the No Action Alternative, Alternative 1, or Alternative 2 to cumulative impacts would be negligible.

4.4.9 Fish

The analysis presented in Section 3.9 (Fish) indicates that fish could be affected by acoustic stressors (tactical acoustic sonar, other acoustic devices, pile driving, underwater explosions, weapons firing noise, aircraft noise, vessel noise), electromagnetic stressors, physical disturbance or strikes (vessels and in-water devices, military expended materials, seafloor devices), entanglement (cables and wires, parachutes), and ingestion (military expended materials). Potential impacts include short-term behavioral and physiological responses. Some stressors could also result in injury or mortality to a relatively small number of individuals but not to ESA-listed fish. No population-level impacts are anticipated. The No Action Alternative, Alternative 1, or Alternative 2 would have no effect on ESA-listed fishes or would be not likely to adversely affect ESA-listed fish. The fish mortality impacts of each alternative could be cumulative with other actions that cause mortality (e.g., commercial fishing). However, the incremental contribution of the No Action Alternative, Alternative 1, or Alternative 2 to cumulative impacts would be negligible.

4.4.10 Cultural Resources

As discussed in Section 3.10 (Cultural Resources), stressors associated with the alternatives would not affect submerged prehistoric sites and submerged historic resources in accordance with Section 106 of the National Historic Preservation Act because measures were previously implemented to protect these resources. The No Action Alternative, Alternative 1, or Alternative 2 are not expected to contribute incrementally to cumulative impacts on cultural resources. Therefore, further analysis of cumulative impacts on cultural resources is not warranted.

4.4.11 SOCIOECONOMIC RESOURCES

The analysis in Section 3.11 (Socioeconomic Resources) indicates that the impacts of the alternatives on socioeconomic resources would be negligible. The No Action Alternative, Alternative 1, or Alternative 2 are not expected to contribute incrementally to cumulative socioeconomic impacts. Therefore, further analysis of cumulative impacts on socioeconomic resources is not warranted.

4.4.12 PUBLIC HEALTH AND SAFETY

The analysis presented in Section 3.12 (Public Health and Safety) indicates that the impacts of the alternatives on public health and safety would be negligible. The No Action Alternative, Alternative 1, and Alternative 2 are not expected to contribute incrementally to cumulative health and safety impacts. Therefore, further analysis of cumulative impacts on public health and safety is not warranted.

4.5 CLIMATE CHANGE AND GREENHOUSE GAS EMISSIONS

4.5.1 INTRODUCTION

Climate change is a global issue, and greenhouse gas emissions are a concern from a cumulative perspective because individual sources of greenhouse gas emissions are not large enough to have an appreciable impact on climate change. This greenhouse gas analysis considers the incremental contribution of Alternatives 1 and 2 to total estimated U.S. greenhouse emissions as compared to the No Action Alternative.

Greenhouse gases are compounds that contribute to the greenhouse effect, a natural phenomenon in which these gases trap heat within the surface-troposphere (lowest portion of the earth's atmosphere) system, causing heating (radiative forcing) at the surface of the earth. Scientific evidence indicates a trend of increasing global temperature over the past century due to increasing greenhouse gas emissions from human activities (U.S. Environmental Protection Agency 2009). The climate change associated with this global warming is predicted to produce negative environmental, economic, and social consequences across the globe. The average global temperature since 1900 has risen by 1.5 degrees Fahrenheit (°F) (0.8 degrees centigrade [°C]) and is predicted to increase by up to 11.5°F (6.4°C) by 2100 (Karl et al. 2009).

Predictions of long-term negative environmental impacts due to global warming include sea level rise, changes in ocean pH 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.

Climate change is likely to negatively impact the Study Area and adjacent shore regions. Since 1970, the annual average temperature in the northeast United States has increased by 2°F (1.1°C), with winter temperatures rising twice this much (Karl et al. 2009). Over the next several decades, temperatures in the northeast United States are projected to rise an additional 2.5 to 4°F (1.4 to 2.2°C) in winter and 1.5 to 3.5°F (0.8 to 1.9°C) in summer. The northeast United States is projected to face continued warming and more extensive climate-related changes, some of which could dramatically alter the region's economy, landscape, character, and quality of life (Karl et al. 2009).

In the southeastern United States, since 1970, annual average temperature has risen about 2°F (1.1°C), with the greatest seasonal increase in temperature occurring during the winter months. Climate models project continued warming in all seasons across the southeast United States and an increase in the rate of warming through the end of this century. The projected rates of warming are more than double those experienced in the southeast United States since 1975, with the greatest temperature increases projected to occur in summer. The intensity of Atlantic hurricanes is likely to increase during this century, with higher peak wind speeds, rainfall intensity, and storm surge height and strength (Karl et al. 2009).

4.5.2 Regulatory Framework

Federal agencies address emissions of greenhouse gases by reporting and meeting reductions mandated in laws, executive orders (EOs), and policies. The most recent of these are EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance* of 5 October 2009, and EO 13423, *Strengthening Federal Environmental, Energy, and Transportation Management* of 26 January 2007.

EO 13514 shifts the way the government operates by (1) establishing greenhouse gases as the integrating metric for tracking progress in federal sustainability, (2) requiring a deliberative planning process, and (3) linking budget allocations and Office of Management and Budget scorecards to ensure goal achievement.

The targets for reducing greenhouse gas emissions discussed in EO 13514 for Scope 1 (direct greenhouse gas emissions from sources that are owned or controlled by a federal agency) and Scope 2 (direct greenhouse gas emissions resulting from the generation of electricity, heat, or steam purchased by a federal agency) have been set for the Department of Defense at a 34 percent reduction of greenhouse gas from the 2008 baseline by 2020. Scope 3 targets (greenhouse gas emissions from sources not owned or directly controlled by a federal agency but related to agency activities such as vendor supply chains, delivery services, and employee travel and commuting) were set at a 13.5 percent reduction. EO 13514, *Strategic Sustainability Performance Plan*, submitted to the Council on Environmental Quality on 2 June 2010 contains a guide for meeting these goals.

EO 13423 established a policy that federal agencies conduct their environmental, transportation, and energy-related activities in support of their respective missions in an environmentally economic way. It included a goal of improving energy efficiency and reducing greenhouse gas emissions of the agency through reduction of energy intensity by 3 percent annually through the end of fiscal year 2015, or 30 percent by the end of fiscal year 2015, relative to the baseline of the agency's energy use in fiscal year 2003.

The *Draft NEPA Guidance on Consideration of the Impacts of Climate Change and Greenhouse Gas Emissions* (Council on Environmental Quality 2010) states that "if a proposed action would be reasonably anticipated to cause direct emissions of 25,000 metric tons or more of carbon dioxide equivalent (CO_2 Eq.) greenhouse gas emissions on an annual basis, agencies should consider this an indicator that a quantitative and qualitative assessment may be meaningful to decision makers and the public."

The Navy is committed to improving energy security and environmental stewardship by reducing reliance on fossil fuels. The Navy is actively developing and participating in energy, environmental, and climate change initiatives that will increase use of alternative energy and help conserve the world's resources for future generations. The Navy Climate Change Roadmap identifies actions the

Environmental Readiness Division is taking to implement EO 13514 (U.S. Department of the Navy 2010). The Navy's Task Force Energy is responding to the Secretary of the Navy's energy goals through energy security initiatives that reduce the Navy's carbon footprint. The Climate Change Roadmap (five-year roadmap) action items, objectives, and desired impacts are organized to focus on strategies, policies and plans; operations and training; investments; strategic communications and outreach; and environmental assessment and prediction.

4.5.3 GREENHOUSE GAS EMISSIONS IN THE UNITED STATES

Greenhouse gas emissions occur from both natural processes and human activities. The primary long-lived greenhouse gases directly emitted by human activities are CO_2, methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. Although CO_2, CH_4, and N_2O occur naturally in the atmosphere, their concentrations have increased by 38 percent, 149 percent, and 23 percent, respectively, from the preindustrial era (1750) to 2007–2008 (U.S. Environmental Protection Agency 2009).

To estimate total greenhouse gas emissions, each greenhouse gas is assigned a global warming potential; that is, the ability of a gas or aerosol to trap heat in the atmosphere. The global warming potential rating system is standardized to CO_2, which has a value of 1. For example, CH_4 has a global warming potential of 21, which means that it has a global warming effect 21 times greater than CO_2 on an equal-mass basis (Intergovernmental Panel on Climate Change 2007). To simplify greenhouse gas analyses, total greenhouse gas emissions from a source are often expressed as CO_2 equivalent (Eq.). The CO_2 Eq. is calculated by multiplying the emissions of each greenhouse gas by its global warming potential and adding the results together to produce a single, combined emission rate representing all greenhouse gases. While CH_4 and N_2O have much higher global warming potentials than CO_2, CO_2 is emitted in much higher quantities, so it is the overwhelming contributor to CO_2 Eq. from both natural processes and human activities. Global warming potential-weighted emissions are presented in terms of equivalent emissions of CO_2, using units of teragrams (Tg) (1 million metric tons, or 1 billion kg) of carbon dioxide equivalents (Tg CO_2 Eq.).

In 2009, the United States generated an estimated 6,633.2 Tg CO_2 Eq. (U.S. Environmental Protection Agency 2011). The 2009 inventory data (U.S. Environmental Protection Agency 2011) show that CO_2, CH_4, and N_2O contributed from fossil fuel combustion processes from mobile and stationary sources (all sectors) include approximately

- 5,505.2 Tg of CO_2
- 686.3 Tg CH_4
- 295.6 Tg N_2O

The 6,633.2 Tg CO_2 Eq. generated in 2009 is a decrease from the 7,263.4 Tg CO_2 Eq. generated in 2007 (U.S. Environmental Protection Agency 2011). Among domestic transportation sources, light-duty vehicles (including passenger cars and light-duty trucks) represented 64 percent of CO_2 emissions, medium- and heavy-duty trucks 20 percent, commercial aircraft 6 percent, and other sources 9 percent. Across all categories of aviation, CO_2 emissions decreased by 21.6 percent (38.7 Tg) between 1990 and 2009. This includes a 59 percent (20.3 Tg) decrease in emissions from domestic military operations. To place military aircraft in context with other aircraft CO_2 emissions, in 2009, commercial aircraft generated 111.4 Tg CO_2 Eq., military aircraft generated 14.1 Tg CO_2 Eq., and general aviation aircraft generated 13.3 Tg CO_2 Eq. Military aircraft represent roughly 10 percent of emissions from the overall jet fuel combustion category.

4.5.4 CUMULATIVE GREENHOUSE GAS IMPACTS

Greenhouse gas emissions were calculated for ships and aircraft (Table 4.5-1 and Appendix D), which contribute the majority of emissions associated with training and testing in the Study Area. Greenhouse gas emissions from minor sources such as munitions, weapons platforms, and auxiliary equipment are considered negligible and were not calculated. Ship greenhouse gas emissions were estimated by determining annual ship fuel (typically diesel) use based on proposed activities and multiplying total annual ship fuel consumption by the corresponding emission factors for CO_2, CH_4, and N_2O. Aircraft greenhouse gas emissions were calculated by multiplying jet fuel use rates by the total operating hours, by the corresponding jet fuel emission factors for CO_2, CH_4, and N_2O, and by the total annual sorties.

Table 4.5-1: Greenhouse Gas Emissions from Ship and Aircraft Training and Testing Activities in the Atlantic Fleet Training and Testing Study Area

Alternative	Annual Emissions (Teragrams)			
	CO_2	N_2O	CH_4	CO_2 Eq.
No Action Alternative	0.89	0.00003	0.00003	0.90
Alternative 1	1.33	0.00005	0.00004	1.35
Increase in emissions for Alternative 1 compared to No Action Alternative	0.44	0.00002	0.00001	0.45
Alternative 2	1.39	0.00005	0.00004	1.37
Increase in emissions for Alternative 2 compared to No Action Alternative	0.50	0.00002	0.00001	0.47

CH_4: methane; CO_2: carbon dioxide; CO_2 Eq.: carbon dioxide equivalent; N_2O: nitrous oxide

Ship and aircraft greenhouse gas emissions are compared to U.S. 2009 greenhouse gas emissions in Table 4.5-2. The estimated CO_2 Eq. emissions from the No Action Alternative are 0.01 percent of the total CO_2 Eq. emissions generated by the United States in 2009. The estimated CO_2 Eq. emissions from Alternatives 1 and 2 would increase because of increased training and testing activities to about 0.02 percent of the total CO_2 Eq. emissions generated by the United States in 2009.

Table 4.5-2: Comparison of Ship and Aircraft Greenhouse Gas Emissions to United States 2009 Greenhouse Gas Emissions

Alternative	Annual Greenhouse Gas Emissions (Teragrams CO_2 Eq.)	Percentage of U.S. 2009 Greenhouse Gas Emissions
No Action Alternative	0.90	0.01%
Alternative 1	1.35	0.02%
Alternative 2	1.37	0.02%
U.S. 2009 greenhouse gas emissions	6,633	

Source: U.S. Environmental Protection Agency 2011
CO_2 Eq.: carbon dioxide equivalent.

4.6 SUMMARY AND CONCLUSIONS

Marine mammals and sea turtles are the primary resources of concern for cumulative impacts analysis:

- Past human activities have impacted these resources to the extent that several marine mammal species and all sea turtles species occurring in the Study Area are ESA-listed. Several marine mammal species have stocks that are classified as strategic stocks under MMPA.
- These resources would be impacted by multiple ongoing and future actions.
- Explosive detonations and vessel strikes under the No Action Alternative, Alternative 1, and Alternative 2 have the potential to disturb, injure, or kill marine mammals and sea turtles.

The aggregate impacts of past, present, and other reasonably foreseeable future actions are expected to result in significant impacts on some marine mammal and all sea turtle species in the Study Area. The No Action Alternative, Alternative 1, or Alternative 2 could contribute to cumulative impacts, but the relative contribution would be low compared to other actions. Compared to potential mortality, strandings, or injury resulting from Navy training and testing activities, marine mammal and sea turtle mortality and injury from bycatch, commercial vessel ship strikes, entanglement, ocean pollution, and other human causes are estimated to be orders of magnitude greater (hundreds of thousands of animals versus tens of animals) (Culik 2004; International Council for the Exploration of the Sea 2005b; Read et al. 2006).

The analysis presented in this chapter and Chapter 3 (Affected Environment and Environmental Consequences) indicate that the incremental contribution of the No Action Alternative, Alternative 1, or Alternative 2 to cumulative impacts on sediments and water quality, air quality, marine habitats, birds, marine vegetation, marine invertebrates, fish, socioeconomic resources, and public health and safety would be negligible. When considered with other actions, the No Action Alternative, Alternative 1, or Alternative 2 might contribute to cumulative impacts on submerged prehistoric and historic resources, if such resources are present in areas where bottom-disturbing training and testing activities take place. The No Action Alternative, Alternative 1, or Alternative 2 would also make an incremental contribution to greenhouse gas emissions, representing approximately 0.01, 0.02, and 0.02 percent of U.S. 2009 greenhouse gas emissions, respectively.

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5 STANDARD OPERATING PROCEDURES, MITIGATION, AND MONITORING

This chapter describes the United States (U.S.) Department of the Navy (Navy) standard operating procedures, mitigation measures, and marine species monitoring and reporting efforts. Standard operating procedures are essential to maintaining safety and mission success, and in many cases have the added benefit of reducing potential environmental impacts. Mitigation measures are designed to help reduce or avoid potential impacts on marine resources. Marine species monitoring efforts are designed to track compliance with take authorizations, evaluate the effectiveness of mitigation measures, and improve understanding of the impacts of training and testing activities on marine resources within the Atlantic Fleet Training and Testing (AFTT) Study Area (Study Area).

5.1 STANDARD OPERATING PROCEDURES

Effective training, maintenance, research, development, testing, and evaluation (hereafter referred to collectively as the Proposed Action) require that participants use their sensors and weapon systems to their optimum capabilities as required by the activity objectives. The Navy currently employs standard practices to provide for the safety of personnel and equipment, including vessels and aircraft, as well as the success of the training and testing activities. For the purpose of this document, the Navy will refer to standard practices as standard operating procedures. Because of their importance for maintaining safety and mission success, standard operating procedures have been considered as part of the Proposed Action under each alternative, and therefore are included in the Chapter 3 (Affected Environment and Environmental Consequences) environmental analyses for each resource.

Navy standard operating procedures have been developed and refined over years of experience, and are broadcast via numerous naval instructions and manuals, including the following sources:

- Ship, submarine, and aircraft safety manuals
- Ship, submarine, and aircraft standard operating manuals
- Fleet Area Control and Surveillance Facility range operating instructions
- Fleet exercise publications and instructions
- Naval Sea Systems Command test range safety and standard operating instructions
- Navy instrumented range operating procedures
- Naval shipyard sea trial agendas
- Research, development, test, and evaluation plans
- Naval gunfire safety instructions
- Navy planned maintenance system instructions and requirements
- Federal Aviation Administration regulations

In many cases there are incidental environmental, socioeconomic, and cultural benefits resulting from standard operating procedures. Standard operating procedures serve the primary purpose of providing for safety and mission success, and are implemented regardless of their secondary benefits. This is what distinguishes standard operating procedures, which are a component of the Proposed Action, from mitigation measures, which are designed entirely for the purpose of reducing environmental impacts resulting from the Proposed Action. Because standard operating procedures are crucial to safety and mission success, the Navy will not modify them as a way to further reduce impacts on environmental resources. Rather, mitigation measures will be used as the tool for avoiding and reducing potential environmental impacts. Standard operating procedures that are recognized as providing a potential secondary benefit are provided below.

5.1.1 Vessel Safety

For the purposes of this chapter, the term "ship" is inclusive of surface ships and surfaced submarines. The term "vessel" is inclusive of ships and small boats (e.g., rigid-hull inflatable boats).

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, 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). Watch personnel are composed of officers, enlisted men and women, and civilian equivalents. Their duties may be performed in conjunction with other job responsibilities, such as navigating the ship or supervising other personnel. While on watch, personnel employ visual search techniques, including the use of binoculars, using a scanning method in accordance with the U.S. 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.

A primary duty of watch personnel is 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 safety requirements, 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. Because watch personnel are primarily posted for safety of navigation, range clearance, and man-overboard precautions, they are not normally posted while ships are moored to a pier. When anchored or moored to a buoy, a watch team is still maintained but with fewer personnel than when underway. When moored or at anchor, watch personnel may maintain security and safety of the ship by scanning the water for any indications of a threat (as described above).

While underway, Navy ships (with the exception of submarines) greater than 65 feet (ft.) (20 meters [m]) in length have at least two watch personnel; Navy ships less than 65 ft. (20 m) in length, surfaced submarines, and contractor ships have at least one watch person. While underway, watch personnel are alert at all times and have access to binoculars. Due to limited manning and space limitations, small boats do not have dedicated watch personnel, and the boat crew is responsible for maintaining the safety of the boat and surrounding environment.

All vessels use extreme caution and proceed at a "safe speed" so they can take proper and effective action to avoid a collision with any sighted object or disturbance, and can be stopped within a distance appropriate to the prevailing circumstances and conditions.

5.1.2 Aircraft Safety

Pilots of Navy aircraft make every attempt to avoid large flocks of birds in order to reduce the safety risk involved with a potential bird strike.

5.1.3 Laser Procedures

The following procedures are applicable to lasers of sufficient intensity to cause human eye damage.

5.1.3.1 Laser Operators

Only properly trained and authorized personnel operate lasers.

5.1.3.2 Laser Activity Clearance

Prior to commencing activities involving lasers, the operator ensures that the area is clear of unprotected or unauthorized personnel in the laser impact area by performing a personnel inspection or a flyover. The operator also ensures that any personnel within the area are aware of laser activities and are properly protected.

5.1.4 WEAPONS FIRING PROCEDURES

5.1.4.1 Notice to Mariners

A Notice to Mariners is routinely issued in advance of missile firing activities. A notice is also issued in advance of explosive bombing activities when they are conducted in an area that does not already have a standing Notice to Mariners. For activities involving large-caliber gunnery, the Navy evaluates the need to publish a Notice to Mariners based on the scale, location, and timing of the activity. More information on the Notices to Mariners is found in Section 3.12.2.1.1 (Sea Space).

5.1.4.2 Weapons Firing Range Clearance

The weapons firing hazard range must be clear of non-participating vessels and aircraft before firing activities will commence. The size of the firing hazard range is based on the farthest firing range capability of the weapon being used. All missile and rocket firing activities are carefully planned in advance and conducted under strict procedures that place the ultimate responsibility for range safety on the Officer Conducting the Exercise or civilian equivalent. All weapons firing is secured when cease fire orders are received from the Range Safety Officer or when the line of fire is endangering any object other than the designated target.

Pilots of Navy aircraft are not authorized to expend ordnance, fire missiles, or drop other airborne devices through extensive cloud cover where visual clearance of the air and surface area is not possible. The two exceptions to this requirement are: (1) when operating in the open ocean, air and surface clearance through visual means or radar surveillance is acceptable, and (2) when the operational commander conducting the exercise accepts responsibility for the safeguarding of airborne and surface traffic.

During activities that involve recoverable targets (e.g., aerial drones), the Navy recovers the target and any associated parachutes to the maximum extent practicable consistent with operational requirements and personnel safety.

5.1.4.3 Target Deployment Safety

Firing exercises involving the integrated maritime portable acoustic scoring system are typically conducted in daylight hours in Beaufort number 4 conditions or better to ensure safe operating conditions during buoy deployment and recovery. The Beaufort sea state scale is a standardized measurement of the weather conditions, based primarily on wind speed. The scale is divided into levels from 0 to 12, with 12 indicating the most severe weather conditions (e.g., hurricane force winds). At Beaufort number 4, wave heights typically range from 3.5 to 5 ft. (1 to 1.5 m).

5.1.5 SWIMMER DEFENSE TESTING PROCEDURES

5.1.5.1 Notice to Mariners

A Notice to Mariners is issued in advance of all swimmer defense testing.

5.1.5.2 Swimmer Defense Testing Clearance

A daily in situ calibration of the source levels is used to establish a clearance area to the 145 decibels (dB) referenced to (re) 1 micro (µ) Pascal (Pa) sound pressure level threshold for non-participant personnel safety. A hydrophone is stationed during the calibration sequences in order to confirm the clearance area. Small boats patrol the 145 dB re 1 µPa sound pressure level area during all test activities. Boat crews are equipped with binoculars and remain vigilant for non-participant divers, boats, swimmers, snorkelers, and dive flags. If a non-participating swimmer, snorkeler, or diver is observed entering into the area of the swimmer defense system, the power levels of the defense system are reduced. An additional 100 yard (yd.) (91 m) buffer is applied to the initial sighting location of the non-participant as an additional precaution. If the area cannot be maintained free of non-participating swimmers, snorkelers, and divers, testing will cease until the non-participant has moved outside the area.

5.1.6 UNMANNED AERIAL AND UNDERWATER VEHICLE PROCEDURES

For activities involving unmanned aerial and underwater vehicles, the Navy evaluates the need to publish a Notice to Airmen or Mariners based on the scale, location, and timing of the activity. Unmanned aerial vehicles and unmanned aircraft systems are operated in accordance with Federal Aviation Administration air traffic organization policy as issued in Office of the Chief of Naval Operations Instructions 3710, 3750, and 4790.

5.1.7 TOWED IN-WATER DEVICE PROCEDURES

Prior to deploying a towed device from a manned platform, there is a standard operating procedure to search the intended path of the device for any floating debris (e.g., driftwood) or other potential obstructions (e.g., concentrations of floating vegetation [*Sargassum* or kelp paddies] and animals), which have the potential to cause damage to the device.

5.1.8 SHIP SHOCK TRIAL PROCEDURES

5.1.8.1 Notice to Mariners

Notices to Mariners and Airmen are issued in advance of all ship shock trial activities.

5.1.8.2 Ship Shock Trial Clearance

A 5 nautical mile (nm) radius is established around the detonation point to exclude all non-participating vessels and aircraft for 5 to 6 hours prior to each detonation. This clearance extends for up to a total of 12 hours per detonation. This area is an electronic emissions control zone that virtually eliminates the possibility of an inadvertent detonation caused by a radio or radar induced electrical current in the explosive firing circuit. This area also provides for safe maneuvering of the explosive laden operations vessel. Since the ship being tested and the operations vessel are not stationary during the ship shock trial activities, the associated area around the detonation point moves. If a non-participating vessel or aircraft is detected within a 10 nm radius of ship shock trial activities, the non-participant is warned to alter course. This is necessary for operational security and to allow large vessels sufficient time to change course to avoid entering the clearance area. Ship shock trial testing is immediately secured when a non-participating vessel or aircraft enters or is detected within the 5 nm clearance area and cannot be contacted. These security measures continue until the area is clear of non-participating vessels and aircraft.

5.1.8.3 Ship Shock Trial Safety

In the unlikely event a charge fails to explode, additional attempts to detonate the charge would occur. If detonation fails, the explosive would be recovered and disarmed. If the explosive cannot be detonated or disarmed, to safeguard human life, the explosive is disposed at sea in accordance with established Ammunition and Explosives Safety Afloat requirements. The location of any disposal is recorded.

5.2 Introduction to Mitigation

The Navy recognizes that the Proposed Action has the potential to impact the environment. Unlike standard operating procedures, which are established for reasons other than environmental benefit, mitigation measures are modifications to the Proposed Action that are implemented for the sole purpose of reducing a specific potential environmental impact on a particular resource. The procedures discussed in this chapter, most of which are currently or were previously implemented as a result of past environmental compliance documents, Endangered Species Act (ESA) Biological Opinions, Marine Mammal Protection Act (MMPA) Letters of Authorization, or other formal or informal consultations with regulatory agencies, have been coordinated with the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service through the consultation and permitting processes.

5.2.1 Regulatory Requirements for Mitigation

An Environmental Impact Statement (EIS) must analyze the affected environment, discuss the environmental impacts of the Proposed Action and each alternative, and assess the significance of the impacts on the environment. Mitigation measures are designed to help reduce the severity or intensity of impacts of the Proposed Action. Assessment of mitigation measures can occur early in the planning process. An agency may choose not to take the action or to move the location of the action. Mitigation measure development also occurs throughout the analysis process whenever an impact is minimized by limiting the degree or magnitude of the action or its implementation. Mitigation measures can also include actions that repair, rehabilitate, or restore the affected environment or reduce impacts over time through constant monitoring and corrective adjustments.

In accordance with the National Environmental Policy Act (NEPA) requirement, the environmental benefit of all Navy-recommended mitigation measures will apply to all alternatives analyzed in this Final EIS, and according to Navy policy, will also apply to the Final Overseas Environmental Impact Statement (OEIS) where applicable and appropriate. Additionally, the White House Council on Environmental Quality issued guidance for mitigation and monitoring on 14 January 2011. This guidance affirms that federal agencies, including the Navy, should:

- commit to mitigation in decision documents when they have based environmental analysis upon such mitigation (by including appropriate conditions on grants, permits, or other agency approvals, and making funding or approvals for implementing the Proposed Action contingent on implementation of the mitigation commitments);
- monitor the implementation and effectiveness of mitigation commitments;
- make information on mitigation and monitoring available to the public, preferably through agency web sites; and
- remedy ineffective mitigation when the federal action is not yet complete.

The Council on Environmental Quality guidance encourages federal agencies to develop internal processes for post-decision monitoring to ensure the implementation and effectiveness of the mitigation. It also states that federal agencies may use adaptive management as part of an agency's action. Adaptive management, when included in the NEPA analysis, allows for the agency to take alternate mitigation actions if mitigation commitments originally made in the planning and decision documents fail to achieve projected environmental outcomes. Adaptive management generally involves four phases: plan, act, monitor, and evaluate. This process allows the use of the results to update knowledge and adjust future management actions accordingly. Through implementation of mitigation measures from the Navy's previous planning, consultations, permits, and monitoring of those efforts, the Navy has collected data to further refine its recommended mitigation measures.

Through the planning, consultation, and permitting processes, federal regulatory agencies suggested that the Navy analyze additional mitigation measures for inclusion in this Final EIS/OEIS and associated consultation and permitting documents. Proposals for additional mitigation measures were based on the federal agency's assessment of the likelihood that such measures will contribute to a notable reduction of the environmental impact. As additional measures were identified, the effectiveness and operational assessment protocols discussed in Section 5.3 (Mitigation Assessment) were applied to determine whether the Navy would recommend the additional measures for implementation. The final suite of mitigations resulting from the ongoing planning, consultation, and permitting processes will be documented in the Navy and NMFS Records of Decision, the MMPA Letters of Authorization, and the ESA Biological Opinions.

5.2.2 Overview of Mitigation Approach

This section describes the approach the Navy took to develop its recommended mitigation measures. The Navy's overall approach to assessing potential mitigation measures was based on two principles: (1) mitigations will be effective at reducing potential impacts on the resource, and (2) from a military perspective, the mitigations are practical to implement, executable, and personnel safety and readiness will not be impacted. The assessment process involved using information directly from Chapter 3 (Affected Environment and Environmental Consequences) and assessing all existing mitigation and proposals for new or modified mitigation in order to determine if recommending a mitigation measure for implementation would be appropriate.

This document organized, and where appropriate, analyzed training and testing activities separately. This separation was needed because the training and testing communities perform activities for differing purposes, and in some cases, with different personnel and in different locations. For example, there is a fundamental difference between the testing of a new mine warfare system with civilian scientists and engineers, and the eventual training of sailors and aviators with that same system. As such, mitigations that the Navy recommends for both training and testing activities are presented together, while mitigations that are designed for and executable only by the training or testing community are presented separately.

5.2.2.1 Lessons Learned from Previous Environmental Impact Statements/Overseas Environmental Impact Statements

In an effort to improve upon past processes, the Navy considered all mitigations previously implemented and adapted its mitigation assessment approach based on lessons learned from previous EISs, ESA Biological Opinions, MMPA Letters of Authorization, and other formal or informal consultations with regulatory agencies. A lesson learned from the previous analysis at test ranges is that relocation of activities to other geographic locations is not feasible. For example, the Naval Surface

Warfare Center, Panama City Division Mission Activities EIS/OEIS considered a relocation alternative but it was rejected for several reasons. Systems command field activities that are co-located with systems command test ranges provide critical infrastructure support and technical expertise necessary to conduct range testing. Logistical support of range testing can only be efficiently and effectively supported when the support is co-located with the testing activities. Test range site locations along with associated field activities were originally established to support specific Navy mission testing needs using a selection process which included but was not limited to testing requirements, cost of living, availability of personnel, and low level of crowding from industry and development. These same principles also apply to pierside and at-sea testing that must occur in proximity to naval shipyards and Navy contractor shipyards. Although some systems command field activity tests may be conducted outside of their testing ranges (e.g., to provide specific technical requirements not available on range), for the majority of tests, it is necessary that tests conducted by systems command field activities be conducted on their test ranges. Systems command field activities with test ranges included in this EIS/OEIS are Naval Surface Warfare Center, Panama City Division; Naval Undersea Warfare Center Division, Newport; and South Florida Ocean Measurement Facility Testing Range.

Similarly, during the Atlantic Fleet Active Sonar Training EIS/OEIS process, geographic alternatives were thoroughly analyzed for impacts on marine resources as well as impacts on training and testing fidelity and effectiveness. The Atlantic Fleet Active Sonar Training EIS/OEIS analyzed three geographic alternatives that would designate: (1) fixed areas for active sonar activities, (2) seasonal active sonar activity areas, or (3) areas of increased awareness where active sonar activities would not take place. Designated areas of increased awareness are defined as environmentally sensitive areas that typically indicate higher concentrations of marine species and include the following features: bathymetric features such as canyons, steep walls, and seamounts; areas of persistent oceanographic features; North Atlantic right whale critical habitat areas; river and bay mouths; areas of high marine mammal density; and designated national marine sanctuaries.

The Record of Decision for the Atlantic Fleet Active Sonar Training EIS/OEIS concluded that implementation of any of the above alternatives would result in severe limitations on access to training and testing areas with features similar to where potential threats operate and would require relocation of approximately 30 percent of the Navy’s current training. Additionally, the Atlantic Fleet Active Sonar Training EIS/OEIS analysis determined that geographically restricting sonar training in areas of increased awareness did not result in a statistically significant decrease in the predicted impacts on marine mammals. It was determined that avoiding these areas of increased awareness would not necessarily result in a reduction of potential impacts.

When considering the outcome of the Atlantic Fleet Active Sonar Training EIS/OEIS analysis, the Naval Surface Warfare Center, Panama City Division EIS/OEIS analysis, the importance of the geographic flexibility required to conduct realistic training and testing, and the continued necessity for mitigation measures to effectively reduce potential environmental impacts, the Navy determined that large geographic restrictions and alternative-specific mitigation measures would not be a practical or effective mitigation scheme for the AFTT EIS/OEIS.

Navy planners, scientists, and the operational community assessed the effectiveness of a full suite of potential mitigation measures (a portion of which were specific mitigation areas) on a case-by-case basis, using lessons learned and information from the Navy’s internal adaptive management process. The resulting assemblage of recommended measures is comprised of currently implemented measures, modifications of currently implemented measures, and newly proposed measures. Details on the assessment methods are provided in Section 5.2.3, Assessment Method. The rationale for recommending, modifying, adding, or discontinuing each measure is provided in Section 5.3, Mitigation Assessment.

5.2.2.2 Protective Measures Assessment Protocol

The Protective Measures Assessment Protocol is a decision support and situational awareness software tool that the Navy uses to facilitate compliance with mitigation measures when conducting certain training and testing activities at sea. The Navy runs the Protective Measures Assessment Protocol program during the event planning process to ensure that personnel involved in the activity are aware of the mitigation requirements and to help ensure that all mitigations are implemented appropriately. In addition to providing notification of the required mitigation, the tool also provides a visual display of the activity location, unit's position in relation to the target area, and any relevant environmental data. The final suite of mitigation measures contained in the Navy and NMFS Records of Decision, the MMPA Letters of Authorization, and the ESA Biological Opinions will be integrated into the Protective Measures Assessment Protocol. Section 5.3.1.1.1.1 (United States Navy Afloat Environmental Compliance Training Series) contains information about the newly developed Protective Measures Assessment Protocol training module.

5.2.3 Assessment Method

As shown in Figure 5.2-1, the Navy undertook an effectiveness assessment and operational assessment for each potential mitigation measure to ensure its compatibility with Section 5.2.2 (Overview of Mitigation Approach). The Navy used information from published and readily available sources, as well as Navy after-action and monitoring reports. When available, these data were used when they represented the best available science and if they were generally accepted by the scientific community to ensure that they were applicable and contributed to the analysis.

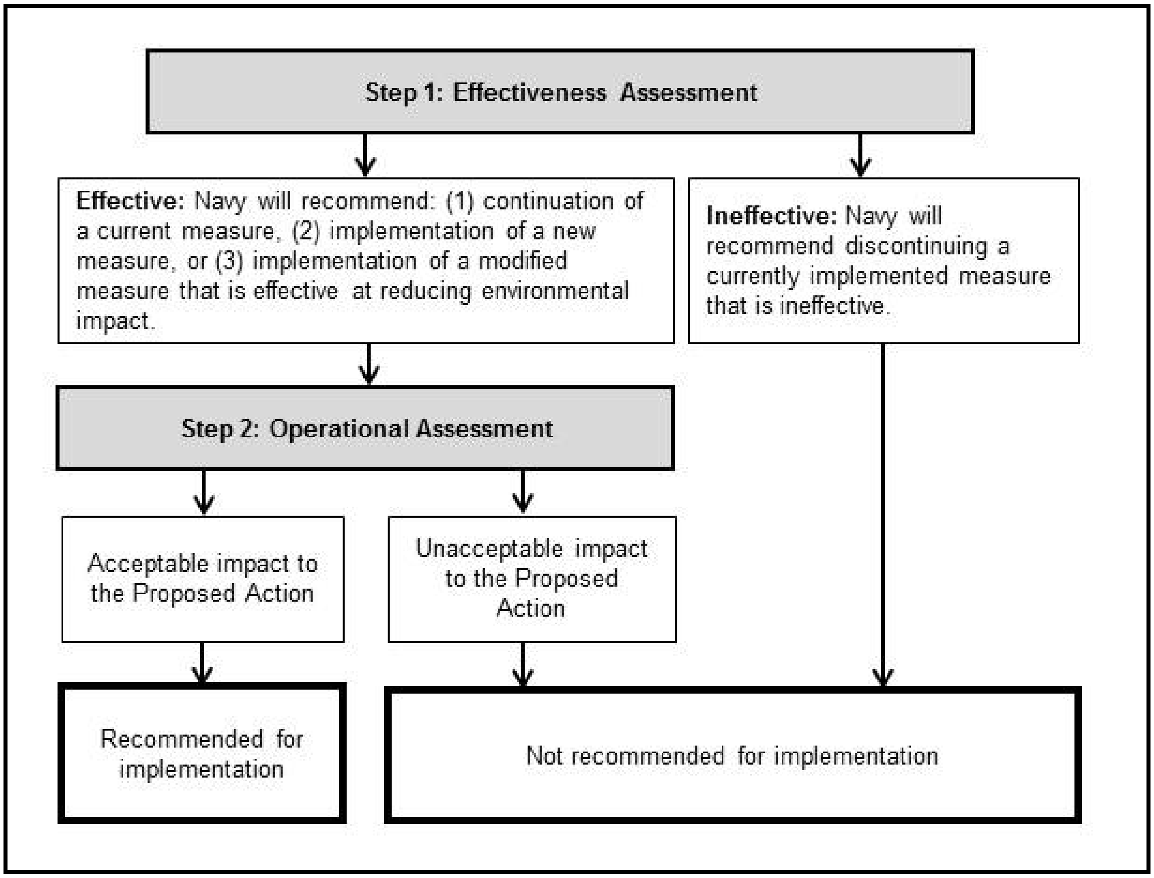

Figure 5.2-1: Flowchart of Process for Determining Recommended Mitigation Measures

5.2.3.1 Effectiveness Assessment

5.2.3.1.1 Procedural Measures

Procedural measures could involve employing techniques or technology during a training or testing activity in order to avoid or reduce a potential impact on a particular resource. For the purposes of organization, procedural measures are discussed within two subcategories: Lookouts and mitigation zones.

A proposed procedural measure was deemed effective if implementing the measure would likely result in avoidance or reduction of an impact on a resource. The level of avoidance or reduction of the impact gained from implementing a procedural measure was weighed against the potential for a shift in impacts resulting from the activity modification. For example, if predictive modeling results indicate that the use of underwater explosives could cause unacceptable impacts on a particular resource; those impacts could possibly be reduced by substituting non-explosive activities for explosive activities. However, if the increased use of non-explosive activities would consequently produce an unacceptable impact on habitats due to an associated physical disturbance or strike risk from military expended materials, the measure would not necessarily be justifiable.

A proposed procedural measure was deemed ineffective if its implementation would not result in avoidance or reduction of an impact on a resource, or if an unacceptable impact will simply be shifted from one resource to another. For ineffective procedural measures that are currently being implemented, the rationale for terminating, modifying, or continuing to carry out the measure is included in the discussion.

5.2.3.1.2 Mitigation Areas

In order to avoid or reduce a potential impact on a particular resource, the Navy would either limit the time of day or duration in which a particular activity could take place, or move or relocate a particular activity outside of a specific geographic area. Within mitigation areas, the measures would only apply to the specific activity that resulted in the requirement for mitigation, and would not prevent or restrict other activities from occurring during that time or in that area.

A proposed mitigation area was deemed effective if implementing the measure would likely result in avoidance or reduction of the impact on the resource. The specific season, time of day, or geographic area must be important to the resource. In determining importance, special consideration was given to time periods or geographic areas having characteristics such as especially high overall density or percent population use, seasonal bottlenecks for a migration corridor, and identifiable key foraging and reproduction areas.

Avoidance or reduction of the impact in the specific time period or geographic area was weighed against the potential for causing new impacts in alternative time periods or geographic areas. For example, if the use of underwater explosives was predicted to cause unacceptable impacts on a particular resource in a known foraging location, those impacts could possibly be reduced by relocating those activities to a new location. However, if the use of explosives at the new location would consequently produce an unacceptable impact on the same or a different resource at the new location, the measure would not necessarily be justifiable.

A proposed mitigation area was deemed ineffective if implementing the measure would not result in avoidance or reduction of an impact on a resource, or if an unacceptable impact would simply be shifted from one time period or location to another. For ineffective mitigation areas that are currently being implemented, the rationale for terminating, modifying, or continuing to carry out the measure is included in the discussion.

5.2.3.2 Operational Assessment

The Navy conducted the operational assessment for procedural measures and mitigation areas using the criteria described below. The Navy deemed procedural and mitigation area measures to have acceptable operational impacts on a particular proposed activity if the following four conclusions were reached:

1. Implementation of the measure will not increase safety risks to Navy personnel and equipment.
2. Implementation of the measure is practical. Practicality was defined by the following factors:
   - The measure does not result in an unacceptable increase in resource requirements (e.g., wear and tear on equipment, additional fuel, additional personnel, increased training or testing requirements, or additional reporting requirements).
   - The measure does not result in an unacceptable increase in time away from homeport for Navy personnel.
   - The measure does not result in national security concerns. Should national security require conducting more than the designated number of activities, or a change in how the Navy conducts those activities, the Navy reserves the right to provide the regulatory federal

agency with prior notification and include the information in any associated exercise or monitoring reports.

- The measure is consistent with Navy policy. Navy policy requires that mitigation measures are developed through consultation with regulatory agencies (e.g., the MMPA and ESA processes), would likely result in avoidance or reduction of an impact on a resource as determined by the effectiveness assessment, and would not negatively impact training and testing fidelity. This policy applies to the full suite of potential mitigation measures that the Navy assessed, including measures that were considered but eliminated, and as appropriate, to currently implemented measures that the Navy is no longer recommending to implement.

3. Implementation of the measure will not result in an unacceptable impact on the effectiveness of the military readiness activity. A primary factor that was considered for all mitigation measures is that the measure must not modify the activity in a way that no longer allows the activity to meet the intended objectives, and ultimately must not interfere with the Navy meeting all of its military readiness requirements. Specifically, for mitigation area measures, the following additional factors were considered:
   - The activity is not dependent on a specific range or range support structure within the mitigation area and there are alternate areas with the necessary environmental conditions (e.g., oceanographic conditions).
   - The mitigation area does not hold any current or foreseeable future readiness value. This assessment will be revisited if Navy operations or national security interests conclude that training or testing needs to occur within the mitigation area.
   - Implementation of the measure will not prohibit conducting shipboard maintenance, repair, and testing pierside prior to at-sea operations.

4. The Navy has legal authority to implement the measure.

If all four of the conditions above can be achieved, then the Navy will recommend the mitigation measure for implementation.

5.3 Mitigation Assessment

The effectiveness and operational assessments resulted in potential mitigation measures being organized into the following four sections:

- Section 5.3.1 (Lookout Procedural Measures) includes recommended measures specific to the use of Lookouts or trained marine species observers.
- Section 5.3.2 (Mitigation Zone Procedural Measures) includes recommended measures specific to visual observations with a mitigation zone.
- Section 5.3.3 (Mitigation Areas) includes recommended measures specific to particular locations.
- Section 5.3.4 (Mitigation Measures Considered but Eliminated) includes measures that the Navy does not recommended for implementation due to the measure being ineffective at reducing environmental impacts, having an unacceptable operational impact, or being incompatible with Section 5.2.2, Overview of Mitigation Approach.

A summary of the Navy-recommended measures is provided in Table 5.4-1.

5.3.1 LOOKOUT PROCEDURAL MEASURES

As described in Section 5.1 (Standard Operating Procedures), ships have personnel assigned to stand watch at all times while underway. Watch personnel may perform watch duties in conjunction with job responsibilities that extend beyond looking at the water or air (such as supervision of other personnel). This section will introduce Lookouts, who perform similar duties to watch personnel and whose duties satisfy safety of navigation and mitigation requirements.

The Navy will have two types of Lookouts for the purposes of conducting visual observations: (1) those positioned on ships, and (2) those positioned in aircraft or on small boats. Lookouts positioned on ships will be dedicated solely to diligent observation of the air and surface of the water. They will have multiple observation objectives, which include but are not limited to detecting the presence of biological resources and recreational or fishing boats, observing the mitigation zones described in Section 5.3.2 (Mitigation Zone Procedural Measures), and monitoring for vessel and personnel safety concerns.

Due to aircraft and small boat manning and space restrictions, Lookouts positioned in aircraft or on small boats may include the aircraft crew, pilot, or boat crew. Lookouts positioned in aircraft and small boats may be responsible for tasks in addition to observing the air or surface of the water (e.g., navigation of a helicopter or small boat). However, aircraft and small boat Lookouts will, considering personnel safety, practicality of implementation, and impact on the effectiveness of the activity, comply with the observation objectives described above for Lookouts positioned on ships.

The procedural measures described below primarily consist of having Lookouts during specific training and testing activities.

5.3.1.1 Specialized Training

5.3.1.1.1 Training for Navy Personnel and Civilian Equivalents

5.3.1.1.1.1 United States Navy Afloat Environmental Compliance Training Series

<u>Recommended Mitigation and Comparison to Current Mitigation</u>

The Navy is proposing to continue implementing the Marine Species Awareness Training for watch personnel and Lookouts, and to add the requirement for additional Navy personnel and civilian equivalents to complete one or more environmental training modules.

The Navy has developed the U.S. Navy Afloat Environmental Compliance Training Series to help ensure Navy-wide compliance with environmental requirements, and to help Navy personnel gain a better understanding of their personal roles and responsibilities. The training series contains four interactive multimedia training modules. Personnel will be required to complete all modules identified in their career path training plan.

The first module is the Introduction to the U.S. Navy Afloat Environmental Compliance Training Series. The introduction module provides information on environmental laws (e.g., ESA and MMPA) and responsibilities relevant to Navy training and testing activities. The material is put into context of why environmental compliance is important to the Navy, from the most junior sailor to Commanding Officers. All personnel completing the U.S. Navy Marine Species Awareness Training will also be required to take this module.

The second module is the U.S. Navy Marine Species Awareness Training. Consistent with current requirements, all bridge watch personnel, Commanding Officers, Executive Officers, maritime patrol aircraft aircrews, anti-submarine warfare helicopter crews, civilian equivalents, and Lookouts will successfully complete the Marine Species Awareness Training prior to standing watch or serving as a Lookout. The module contained within the U.S. Navy Environmental Compliance Training Series is an update to the current Marine Species Awareness Training version 3.1. The updated training is designed to improve the effectiveness of visual observations for marine resources, including marine mammals and sea turtles. The Marine Species Awareness Training provides information on sighting cues, visual observation tools and techniques, and sighting notification procedures.

The third module is the U.S. Navy Protective Measures Assessment Protocol. The Protective Measures Assessment Protocol is a decision support and situational awareness software tool that the Navy uses to facilitate compliance with worldwide mitigation measures during the conduct of training and testing activities at sea. The module provides instruction for generating and reviewing Protective Measures Assessment Protocol reports. Section 5.2.2.2 (Protective Measures Assessment Protocol) contains additional information on the benefits of the software tool.

The fourth module is the U.S. Navy Sonar Positional Reporting System and Marine Mammal Incident Reporting. The Navy developed the Sonar Positional Reporting System as its official record of underwater sound sources (e.g., active sonar) used under its MMPA permits. Marine mammal incidents include vessel strikes and animal strandings. The module provides instruction on the reporting requirements and procedures for both the Sonar Positional Reporting System and marine mammal incident reporting.

Effectiveness and Operational Assessment

Navy personnel undergo extensive training in order to stand watch. Standard training includes on-the-job instruction under the supervision of experienced personnel, followed by completion of the Personal Qualification Standard program. The Personal Qualification Standard program certifies that personnel have demonstrated the skills needed to stand watch, such as detecting and reporting floating or partially submerged objects.

The U.S. Navy Afloat Environmental Compliance Training Series, including the updated Marine Species Awareness Training, is a specialized multimedia training program designed to help Navy operational and test communities best avoid potentially harmful interactions with marine species. The program provides training on how to sight marine species, focusing on marine mammals. The training also includes instruction for visually identifying sea turtles, concentrations of floating vegetation (*Sargassum* or kelp paddies), jellyfish aggregations, and flocks of seabirds, which are often indicators of marine mammal or sea turtle presence. The Marine Species Awareness Training also addresses the role that watch personnel and Lookouts play in helping the Navy maintain compliance with environmental protection requirements, as well as supporting Navy environmental stewardship commitments.

In summary, the Navy believes that the U.S. Navy Afloat Environmental Compliance Training Series, including the updated Marine Species Awareness Training, is the best and most appropriate forum for teaching watch personnel and Lookouts about their responsibilities for helping reduce impacts on the marine environment. The Marine Species Awareness Training provides the Navy with invaluable training for a relatively large number of personnel. Constantly shifting personnel assignments presents a real challenge; however, the format and structure of the U.S. Navy Afloat Environmental Compliance Training Series will help the Navy reduce costs during fiscally constrained periods and provide constant access to training. Overall, the Marine Species Awareness Training is an effective tool for improving the potential for Lookouts to detect marine species while on duty.

Implementation of the Marine Species Awareness Training has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.1.2 Lookouts

The Navy proposes to use one or more Lookouts during the training and testing activities described below, which are organized by stressor category. A comparison of the currently implemented mitigation measures and recommended mitigation measures are provided where applicable. The effectiveness and operational assessments are discussed for all Lookout measures collectively in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts) and Section 5.3.1.2.5 (Operational Assessment for Lookouts). A number of training and testing activities involve the participation of multiple vessels and aircraft, which could ultimately increase the cumulative number of personnel standing watch per standard operating procedures or Lookouts posted in the vicinity of the activity (e.g., sinking exercises). The following sections discuss the minimum number of Lookouts the Navy will use during each activity.

5.3.1.2.1 Acoustic Stressors – Non-Impulsive Sound

5.3.1.2.1.1 Low-Frequency and Hull-Mounted Mid-Frequency Active Sonar

Mitigation measures do not currently exist for low-frequency active sonar sources analyzed in this Final EIS/OEIS, or new platforms or systems. The Navy is proposing to (1) add mitigation measures for low-frequency active sonar and new platforms and systems, and (2) maintain the number of Lookouts currently implemented for ships using hull-mounted mid-frequency active sonar. The recommended measures are provided below.

Ships using low-frequency or hull-mounted mid-frequency active sonar sources associated with anti-submarine warfare and mine warfare activities at sea (with the exception of ships less than 65 ft. [20 m] in length and ships that are minimally manned) will have two Lookouts at the forward position. For the purposes of this document, low-frequency active sonar does not include Surveillance Towed Array Sensor System (SURTASS) Low-Frequency Active (LFA) sonar.

While using low-frequency or hull-mounted mid-frequency active sonar sources associated with anti-submarine warfare and mine warfare activities at sea, ships less than 65 ft. (20 m) in length and ships that are minimally manned will have one Lookout at the forward position due to space and manning restrictions.

Ships conducting active sonar activities while moored or at anchor (including pierside) will maintain one Lookout.

5.3.1.2.1.2 High-Frequency and Non-Hull Mounted Mid-Frequency Active Sonar

Mitigation measures do not currently exist for high-frequency active sonar activities associated with anti-submarine warfare and mine warfare, or for new platforms, such as the Littoral Combat Ship; therefore, the Navy is proposing to add a new measure for these activities or platforms. The Navy is proposing to continue using the number of Lookouts currently implemented for ships or aircraft conducting non-hull mounted mid-frequency active sonar, such as helicopter dipping sonar systems. The recommended measure is provided below.

The Navy will have one Lookout on ships or aircraft conducting high-frequency or non-hull mounted mid-frequency active sonar activities associated with anti-submarine warfare and mine warfare activities at sea.

5.3.1.2.2 Acoustic Stressors – Explosives and Impulsive Sound

5.3.1.2.2.1 Improved Extended Echo Ranging Sonobuoys

The Navy is proposing to continue using the number of Lookouts currently implemented for this activity. The Navy will have one Lookout in an aircraft conducting Improved Extended Echo Ranging sonobuoy activities.

5.3.1.2.2.2 Explosive Sonobuoys Using 0.6–2.5 Pound Net Explosive Weight

Lookout measures do not currently exist for explosive sonobuoy activities using 0.6–2.5 pound (lb.) net explosive weight. The Navy is proposing to add this measure. Aircraft conducting explosive sonobuoy activities using 0.6–2.5 lb. net explosive weight will have one Lookout.

5.3.1.2.2.3 Anti-Swimmer Grenades

The Navy is proposing to continue using the number of Lookouts currently implemented for this activity. The Navy will have one Lookout on the vessel conducting anti-swimmer grenade activities.

5.3.1.2.2.4 Mine Countermeasure and Neutralization Activities Using Positive Control Firing Devices

As background, mine countermeasure and neutralization activities can be divided into two main categories: (1) general activities that can be conducted from a variety of platforms and locations, and (2) activities involving the use of diver-placed charges that typically occur close to shore. When either of these activities are conducted using a positive control firing device, the detonation is controlled by the personnel conducting the activity and is not authorized until the area is clear at the time of detonation.

The Navy is proposing to modify the number of Lookouts currently implemented for general mine countermeasure and neutralization activities using positive control firing devices to account for additional categories of net explosive weights. The recommended measures are provided below.

- During general mine countermeasure and neutralization activities under positive control using up to a 500 lb. net explosive weight detonation (bin E10 and below), vessels greater than 200 ft. (61 m) will have two Lookouts, while vessels less than 200 ft. (61 m) or aircraft will have one Lookout.
- During general mine countermeasure and neutralization activities under positive control using a 501–650 lb. net explosive weight (bin E11) detonation, the Navy will have two Lookouts (one positioned in an aircraft and one in a small boat).

The Navy is proposing to (1) continue using the number of Lookouts currently implemented for mine neutralization activities using diver-placed charges up to a 20 lb. net explosive weight under positive control, and (2) extend the implementation of its current mitigation to all additional categories of net explosive weights. Mitigation measures for activities involving diver-placed charges under positive control do not currently exist for 21–100 lb. net explosive weight detonations. The recommended measures are provided below.

- During activities involving diver-placed mines under positive control, activities using up to a 100 lb. net explosive weight (bin E8) detonation will have a total of two Lookouts (one Lookout positioned on two small boats or on one boat and in one helicopter).
- All divers placing the charges on mines will support the Lookouts while performing their regular duties. The divers will report all marine mammal and sea turtle sightings to their supporting small boat or Range Safety Officer.

5.3.1.2.2.5 Mine Neutralization Activities Using Diver-Placed Time-Delay Firing Devices

As background, when mine neutralization activities using diver-placed charges (up to a 20 lb. net explosive weight) are conducted with a time-delay firing device, 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. During these activities, the detonation cannot be terminated once the fuse is initiated due to human safety concerns.

Current mitigation involves the use of six Lookouts and three small boats (two Lookouts positioned in each of the three boats) for mitigation zones equal to or larger than 1,400 yd. (1,280 m), or four Lookouts and two small boats for mitigation zones smaller than 1,400 yd. (1,280 m). The Navy is proposing to modify the number of Lookouts currently used for mine neutralization activities using diver-placed time-delay firing devices because the measure is impractical to implement and is currently resulting in an unacceptable impact on military readiness. The Navy does not have the resources to maintain six Lookouts and three small boats during mine neutralization activities using diver-placed time-delay firing devices. Due to a lack of personnel and small boats available for this activity, the requirement for six Lookouts and three small boats would require reassigning personnel from other assigned duties or training activities, thus impacting the ability of the reassigned personnel to complete his or her assigned duties or other training requirements. Therefore, the Navy is currently unable to conduct the activities that require six Lookouts and three small boats, which is reducing the Navy's ability to maintain military readiness for these activities. Four Lookouts and two small boats represent the maximum level of effort that the Navy can commit to observing mitigation zones for this activity given the number of personnel and assets available. To prevent these unacceptable impacts, the Navy recommends the following measures:

During activities using up to a 20 lb. net explosive weight (bin E6) detonation, the Navy will have four Lookouts and two small boats (two Lookouts positioned in each of the two boats). In addition, when aircraft are used, the pilot or member of the aircrew will serve as an additional Lookout. All divers placing the charges on mines will support the Lookouts while performing their regular duties. The divers will report all marine mammal and sea turtle sightings to their supporting small boat or Range Safety Officer.

5.3.1.2.2.6 Gunnery Exercises – Small- and Medium-Caliber Using a Surface Target

The Navy is proposing to continue using the number of Lookouts currently implemented for this activity. The Navy will have one Lookout on the vessel or aircraft conducting small- or medium-caliber gunnery exercises against a surface target.

5.3.1.2.2.7 Gunnery Exercises – Large-Caliber Using a Surface Target

The Navy is proposing to continue using the number of Lookouts currently implemented for this activity. The Navy will have one Lookout on the ship conducting large-caliber gunnery exercises against a surface target.

5.3.1.2.2.8 Missile Exercises (Including Rockets) up to 250 Pound Net Explosive Weight Using a Surface Target

The Navy is proposing to continue using the number of Lookouts currently implemented for this activity. When aircraft are conducting missile exercises up to 250 lb. net explosive weight against a surface target, the Navy will have one Lookout positioned in an aircraft.

5.3.1.2.2.9 Missile Exercises Using 251–500 Pound Net Explosive Weight Using a Surface Target

Lookout measures do not currently exist for missile exercises using 251–500 lb. net explosive weight. The Navy is proposing to add this measure. When aircraft are conducting missile exercises using 251–500 lb. net explosive weight against a surface target, the Navy will have one Lookout positioned in an aircraft.

5.3.1.2.2.10 Bombing Exercises

The Navy is proposing to continue using the number of Lookouts currently implemented for this activity. The Navy will have one Lookout positioned in an aircraft conducting bombing exercises.

5.3.1.2.2.11 Torpedo (Explosive) Testing

The Navy is proposing to continue using the number of Lookouts currently implemented for this activity. The Navy will have one Lookout positioned in an aircraft during torpedo (explosive) testing.

5.3.1.2.2.12 Sinking Exercises

The Navy is proposing to continue using the number of Lookouts currently implemented for this activity. The Navy will have two Lookouts (one positioned in an aircraft and one on a vessel) during sinking exercises.

5.3.1.2.2.13 At-Sea Explosive Testing

Lookout measures do not currently exist for at-sea explosive testing. The Navy is proposing to add this measure. The Navy will have a minimum of one Lookout on each vessel supporting at-sea explosive testing.

5.3.1.2.2.14 Ordnance Testing – Line Charge Testing

The Navy is proposing to continue using the number of Lookouts currently implemented for this activity. The Navy will have one Lookout on the surface vessel conducting line charge testing.

5.3.1.2.2.15 Ship Shock Trials

The Navy develops detailed ship shock trial mitigation plans approximately 1 year prior to each ship shock trial event and will continue to provide these plans to NMFS. The recommended Lookout measures specific to ship shock trials using 10,000-lb. and 40,000-lb. charges are provided below.

10,000-Pound Charges (High Blast Explosive)

The Navy is proposing to (1) continue implementing Lookout measures based on the most recently conducted ship shock trial (Mesa Verde, which used 10,000-lb. charges), (2) provide the option to use either shipboard observations or a combination of aerial and shipboard observations, and (3) allow the use of either Lookouts or trained marine species observers, or a combination of both. Trained marine species observers are different from Lookouts in that they are contracted civilians with experience in locating and identifying animals from shipboard and aerial platforms. The recommended measures are provided below.

Prior to commencing, during, and after completion of ship shock trials using up to 10,000-lb. charges, the Navy will have 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, there will be Lookouts or trained marine species observers positioned in an aircraft and positioned on multiple vessels. If vessels are the only platform, a sufficient number of additional Lookouts or trained marine species observers will be used to provide visual observation of the mitigation zone comparable to that achieved by aerial surveys. Due to the manning requirement associated with ship shock trial mitigation, the Navy typically prefers to use trained marine species observers whenever possible for ship shock trials, and will use Lookouts if the use of marine species observers is not practical due to availability or other constraints. Details will be provided in the ship-specific mitigation plan.

40,000-Pound Charges (High Blast Explosive)

Lookout measures do not currently exist for this activity because it is a new activity. The Navy is proposing to add mitigation for this activity. The recommended measures are provided below.

Prior to commencing, during, and after completion of ship shock trials using up to 40,000-lb. charges, the Navy will have at least 10 Lookouts or trained marine species observers (or a combination thereof) positioned in an aircraft and on multiple vessels (i.e., a Marine Animal Response Team boat and the test ship). Details will be provided in the ship-specific mitigation plan.

5.3.1.2.2.16 Elevated Causeway System – Pile Driving

Lookout measures do not currently exist for elevated causeway system pile driving activities. The Navy is proposing to add this measure. The Navy will have one Lookout positioned on the platform (which could include the shore, an elevated causeway, or on a small boat) that will maximize the potential for sightings during pile driving and pile removal.

5.3.1.2.2.17 Weapons Firing Noise During Gunnery Exercises – Large-Caliber

The Navy is proposing to continue using the number of Lookouts currently implemented for this activity. The Navy will have one Lookout on the ship conducting explosive and non-explosive large-caliber gunnery exercises. This may be the same Lookout described in Section 5.3.1.2.2.7 (Gunnery Exercises – Large-Caliber Using a Surface Target) or Section 5.3.1.2.3.3 (Non-Explosive Practice Munitions – Small-, Medium-, and Large-Caliber Gunnery Exercises Using a Surface Target) when the large-caliber gunnery exercise is conducted from a ship against a surface target.

5.3.1.2.3 Physical Disturbance and Strikes

5.3.1.2.3.1 Vessels

The Navy is proposing to continue using the mitigation measures currently implemented for this activity (including full power propulsion testing). While underway, vessels will have a minimum of one Lookout.

5.3.1.2.3.2 Towed In-Water Devices

The Navy is proposing to continue using the number of Lookouts currently implemented for activities using towed in-water devices (e.g., towed mine neutralization). The Navy will have one Lookout during activities using towed in-water devices when towed from a manned platform.

5.3.1.2.3.3 Non-Explosive Practice Munitions – Small-, Medium-, and Large-Caliber Gunnery Exercises Using a Surface Target

The Navy is proposing to continue using the number of Lookouts currently implemented for these activities. The Navy will have one Lookout during activities involving non-explosive practice munitions (e.g., small-, medium-, and large-caliber gunnery exercises) against a surface target.

5.3.1.2.3.4 Non-Explosive Practice Munitions – Bombing Exercises

The Navy is proposing to continue using the number of Lookouts currently implemented for these activities. The Navy will have one Lookout positioned in an aircraft during non-explosive bombing exercises.

5.3.1.2.3.5 Non-Explosive Practice Munitions – Missile Exercises (Including Rockets) Using a Surface Target

The Navy is proposing to continue using the number of Lookouts currently implemented for these activities. When aircraft are conducting non-explosive missile exercises (including exercises using rockets) against a surface target, the Navy will have one Lookout positioned in an aircraft.

5.3.1.2.4 Effectiveness Assessment for Lookouts

Personnel standing watch in accordance with Navy standard operating procedures have multiple job responsibilities. While on duty, these standard watch personnel often conduct marine species observation in addition to their primary job duties (e.g., aiding in the navigation of a vessel). By having one or more Lookouts dedicated solely to observing the air and surface of the water during certain training and testing activities, the Navy increases the likelihood that marine species will be detected. It is also important to note that a number of training and testing activities involve multiple vessels and aircraft, thereby increasing the cumulative number of Lookouts or watch personnel who could potentially be present during a given activity.

Although using Lookouts is expected to increase the likelihood that marine species will be detected at the surface of the water, it is unlikely that using Lookouts will be able to help avoid impacts on all species entirely due to the inherent limitations of sighting marine mammals and sea turtles, as discussed in the sections below. Refer to Section 3.4.3.1.5.6 (Implementing Mitigation to Reduce Sound Exposures) for a quantitative discussion on the Navy's effectiveness assessment for Lookouts during sound-producing activities.

Pursuant to Phase I (e.g., Atlantic Fleet Active Sonar Training EIS/OEIS) and in cooperation with NMFS, the Navy has undertaken monitoring efforts to track compliance with take authorizations, help evaluate the effectiveness of implemented mitigation measures, and gain a better understanding of the impacts of Navy activities on marine resources. In 2010, the Navy initiated a study designed to evaluate the effectiveness of the Navy Lookout team. The University of St. Andrews, Scotland, under contract to the U.S. Navy, developed an initial data collection protocol for use during the study. Between 2010 and 2012, trained Navy marine mammal observers collected data during nine field trials as part of a "proof of concept" phase. The goal of the proof of concept phase was to develop a statistically valid protocol for quantitatively analyzing the effectiveness of Lookouts during Navy training exercises. Field trials were conducted in the Hawaii Range Complex, Southern California Range Complex, and Jacksonville (JAX) Range Complex onboard one frigate, one cruiser, and seven destroyers. Preliminary analysis of the proof of concept data is ongoing. The Navy is also working to finalize the data collection process for use during the next phase of the study. While data was collected as part of this proof of concept phase, those data are not fairly comparable because protocols were being changed and assessed, nor are those data statistically significant. Therefore, it is improper to use these data to draw any conclusions on the effectiveness of Navy lookouts.

5.3.1.2.4.1 Detection Probabilities of Marine Mammals in the Study Area

Until results of the Navy's Lookout effectiveness study are available, the Navy must rely on the best available science to determine detection probabilities of marine mammals by Navy Lookouts. To do so, the Navy compiled results of available literature on line-transect analyses, which are typically used to estimate cetacean abundance. In line-transect analyses, the factors affecting the detection of an animal or group of animals directly on the transect line may be probabilistically quantified as g(0). As a reference, a g(0) value of 1 indicates that animals on the transect line are always detected. Table 5.3-1 provides detection probabilities for cetacean species based largely on g(0) values derived from shipboard and aerial surveys in the Study Area, which vary widely based on g(0) derivation factors (e.g., species, sighting platforms, group size, and sea state conditions). Refer to Section 3.4.3.1.5.6 (Implementing Mitigation to Reduce Sound Exposures) for additional background on g(0) and a discussion of how the Navy used g(0) to quantitatively assess the effectiveness of Lookouts during sound-producing activities.

Table 5.3-1: Sightability Based on Average g(0) Values for Marine Mammal Species in the Study Area

Species	Family	Vessel Sightability[1]	Aircraft Sightability[1]
Atlantic Spotted Dolphin	Delphinidae	0.665	0
Atlantic White-Sided Dolphin	Delphinidae	0.325	0.675
Beaked Whales	Ziphiidae	0.485	0.2
Blue Whale	Balaenopteridae	0.95	0.41
Bottlenose Dolphin	Delphinidae	0.805	0.675
Bryde's Whale	Balaenopteridae	0.95	0
Common Dolphin (Long-Beaked)	Delphinidae	0.735	0.675
False Killer Whale	Delphinidae	0.87	0
Fin Whale	Balaenopteridae	0.63	0.2
Fraser's Dolphin	Delphinidae	0.88	0.675
Harbor Porpoise	Phocoenidae	0.54	0.365
Humpback Whale	Balaenopteridae	0.2	0.605
Killer Whale	Delphinidae	0.9	0.965
Kogia species (Dwarf Sperm Whale, Pygmy	Kogiidae	0.42	0
Melon-Headed Whale	Delphinidae	0.87	0
Minke Whale	Balaenopteridae	0.505	0.2
North Atlantic Right Whale	Balaenidae	0.645	0.41
Pantropical Spotted Dolphin	Delphinidae	0.665[2]	0
Pilot Whale	Delphinidae	0.575	0.24
Pygmy Killer Whale	Delphinidae	0.87	0
Risso's Dolphin	Delphinidae	0.675	0.675
Rough-Toothed Dolphin	Delphinidae	0.87	0
Sei Whale	Balaenopteridae	0.92	0
Sperm Whale	Physeteridae	0.425	0.24
Spinner Dolphin	Delphinidae	0.685	0
Striped Dolphin	Delphinidae	0.485	0

[1] Values reported are averaged based on the data cited for the U.S. Atlantic coast, U.S. west coast, and Hawaii. Some g(0) values in the table above are estimates of perception bias only, some are estimates of availability bias only, and some reflect both, depending on the species and the Navy's analysis of available data (Barlow 1995; Barlow 2003; Barlow and Forney 2007; Barlow et al. 1997; Barlow and Gerrodette 1996; Barlow and Sexton 1996; Barlow and Taylor 2005; Blaylock et al. 1995; Carretta et al. 2000; Forney 2007; Forney et al. 1995; Hain et al. 1999; Mobley et al. 2001; Palka 1995a; Palka 1995b, 2005a, b, 2006).
[2] g(0) values were either determined by the source or applied by the source for abundance/density estimation analyses.

Several variables that play into how easily a marine mammal may be detected by a dedicated observer are directly related to the animal, including its external appearance and size; surface, diving, and social behavior; and life history. The following is a generalized discussion of the behavior and external appearance of the marine mammals with the potential to occur in the Study Area as these characters relate to the detectability of each species. The species are grouped loosely based on either taxonomic relatedness or commonalities in size and behavior, and include large whales, cryptic species delphinids, beluga whales, and pinnipeds. Not all statements may hold true for all species in a grouping and exceptions are mentioned where applicable. The information presented in this section may be found in Jefferson et al. (2008) and sources within unless otherwise noted.

Large Whales

Species of large whales found in the Study Area include all the baleen whales and the sperm whale. Baleen whales are generally large, with adults ranging in size from 30–89 ft. (9–27 m), often making them immediately detectable. Many species of baleen whales have a prominent blow ranging from 10 ft. (3 m) to as much as 39 ft. (12 m) above the surface. However, there are at least two species (Bryde's whale and common minke whale) that often have no visible blow. Baleen whales tend to travel singly or in small groups ranging from pairs to groups of five. The exception to this is the fin whale, which is known to travel in pods of seven or more individuals. All species of baleen whales are known to form larger-scale aggregations in areas of high localized productivity or on breeding grounds. Baleen whales may or may not fluke at the surface before they dive; some species fluke regularly (e.g., the humpback whale and North Atlantic right whale), some fluke variably (e.g., the blue whale and fin whale) and some rarely fluke (e.g., the sei whale, common minke whale, and Bryde's whale). Baleen whales may remain at the surface for extended periods of time as they forage or socialize. North Atlantic right whales are known to form surface-active groups and humpback whales are known to corral prey at the surface. Dive behavior varies amongst species. Many species will dive and remain at depth for as long as 30 minutes (min.). Some will adjust their diving behavior according to the presence of vessels (e.g., the North Atlantic right whale, humpback whale, and fin whale). Sei whales are known to sink just below the surface and remain there between breaths.

Sperm whales also belong to the large whales, with adult males reaching as much as 50 ft. (18 m) in total length. Sperm whales at the surface would likely be easy to detect. They have a prominent 16 ft. (5 m) blow, and may remain at the surface for long periods of time. They are known to raft (i.e., loll at the surface) and to form surface-active groups when socializing. Sperm whales may travel or congregate in large groups of as many as 50 individuals. Although sperm whales engage in conspicuous surface behavior such as fluking, breaching, and tail-slapping, they are long, deep divers and may remain submerged for over 1 hour.

Cryptic Species

Cryptic and deep-diving species are those not at the surface for long periods of time and are often difficult to see when they surface, which ultimately limits the ability of observers to detect them even in good sighting conditions (Barlow et al. 2006). Cryptic species include beaked whales (family Ziphiidae), dwarf and pygmy sperm whales (*Kogia* species), and harbor porpoises. Beaked whales are difficult to detect at sea. In the Study Area, beaked whales may occur in a variety of group sizes, ranging from single individuals to groups of as many as 22 individuals (MacLeod and D'Amico 2006). Beaked whale diving behavior in general consists of long, deep dives that may last for nearly 90 min. followed by a series of shallower dives and intermittent surfacings (Baird et al. 2008; Tyack et al. 2006). Some individuals remain at the surface for an extended period of time (perhaps 1 hour or more) or make shorter dives (MacLeod and D'Amico 2006). Detection of beaked whales is further complicated because beaked whales often dive and surface in a synchronous pattern and they travel below the surface of the water (MacLeod and D'Amico 2006).

Dwarf and pygmy sperm whales (referred to broadly as *Kogia* species) are small cetaceans (10–13 ft. [3–4 m] adult length) that are not commonly seen. *Kogia* species are some of the most commonly stranded species in some areas, which suggests that sightings are not indicative of their overall abundance. This supports the idea that they are cryptic, perhaps engaging in inconspicuous surface behavior or actively avoiding vessels. When *Kogia* species are sighted, they are typically seen in groups of no more than five to six individuals. They have no visible blow, do not fluke when they dive, and are known to log (i.e., lie motionless) at the surface. When they do dive, they often will sink out of sight with no prominent behavioral display.

Harbor porpoises are difficult to detect in all but the best of conditions (i.e., no swell, no whitecaps). Harbor porpoises travel singly or in small groups of less than six individuals, but may aggregate into groups of several hundred. They are inconspicuous at the surface, rarely lifting their heads above the surface and often lying motionless. They are small and may actively avoid vessels.

Delphinids

Delphinids are some of the most likely species to be detected at sea by observers. Many species of delphinids engage in very conspicuous surface behavior, including leaping, spinning, bow riding, and traveling along the surface in large groups. Delphinid group sizes may range from 10 to 10,000 individuals, depending on the species and the geographic region. Species such as pilot whales, rough-toothed dolphins, white-beaked dolphins, white-sided dolphins, bottlenose dolphins, stenellid dolphins, common dolphins, and Fraser's dolphins are known to either actively approach and investigate vessels, or bow ride along moving vessels. Fraser's dolphins and common dolphins form huge groups that travel quickly along the surface, churning up the water and making them visible from a great distance. Delphinids may dive for as little as 1 min. to more than 30 min., depending on the species.

Beluga Whales

Beluga whales can reach up to 16 ft. (5 m) in total length and individuals are often all white or gray in color. They travel in groups ranging from 15 individuals to thousands. They dive for lengths of up to 25 min. In some locations during periods of the year, aerial surveys have been successful at detecting belugas when they are concentrated along the ice edge. During portions of the year, beluga whales may not be available to be detected when swimming under the ice shelf. Vessel surveys have typically found it difficult to detect belugas in the nearshore environment with high turbidity levels (Division of Fisheries and Oceans 2013). Because of the white coloring of most individuals, belugas usually have a relatively good probability of being detected if animals are not swimming under the ice shelf or in turbid nearshore waters.

Pinnipeds

Pinnipeds (e.g., seals) are more difficult to detect at sea than cetaceans. Seals are much smaller, often solitary, and generally do not engage in conspicuous surface behavior. There is not a lot of information regarding seal behavior at sea. Pinnipeds have a low profile, no dorsal appendage, and small body size in comparison with most cetaceans, which limits accurate visual detection to sea states of less than 2 on the Beaufort scale (Carretta et al. 2000). Some species, such as harbor seals, are known to approach and observe human activities on land or on stationary vessels. Harbor seals and gray seals are solitary at sea. Harp seals appear to be an exception, traveling in large groups at the surface and churning up whitewater like dolphins. Gray seals are known to rest vertically at the surface with only the head exposed. Gray seals may dive for as long as 30 min. and hooded seals for up to 60 min.

Manatees

The West Indian manatee is gray or gray-brown, slow-moving, and reaches a maximum length of 12.8 ft. (3.9 m). Manatees are found in coastal marine, brackish, and freshwater habitats. Manatees are not gregarious and are most often observed alone, except for large groups that aggregate around warm-water outfalls during winter months (Hartman 1979). Manatees can be difficult to detect from vessels because they can submerge for extended periods of time, and when they surface, very little of the animal is visible. They can be more easily seen from aircraft, but detectability depends on a variety of factors, one of which is water clarity.

5.3.1.2.4.2 Detection Probabilities of Sea Turtles in the Study Area

Sea turtles spend a majority of their time below the surface and are difficult to sight from a vessel until the animal is at close range (Hazel et al. 2007). Sea turtles often spend over 90 percent of their time underwater and are not visible more than 6.5 ft. (2 m) below the surface (Mansfield 2006). Sea turtles are generally much smaller than cetaceans, so while shipboard surveys designed for sighting marine mammals are adequate for detecting large sea turtles (e.g., adult leatherbacks), they are usually not adequate for detecting the smaller sized turtles (e.g., juveniles and Kemp's ridleys). Juvenile sea turtles may be especially difficult to detect. Aerial detection may be more effective in spotting sea turtles on the surface, particularly in calm seas and clear water, but it is possible that the smallest age classes are not detected even in good conditions (Marsh and Saalfeld 1989). Visual detection of sea turtles, especially small turtles, is further complicated by their startle behavior in the presence of vessels. Turtles on the surface may dive below the surface of the water in the presence of a vessel before it is detected by shipboard or aerial observers (Kenney 2005). The detection probability of sea turtles is generally lower than that of cetaceans. The use of Lookouts for visual detection of sea turtles is likely effective only at close range, and is thought to be less effective for small individuals than large individuals.

5.3.1.2.4.3 Summary of Lookout Effectiveness

Due to the various detection probabilities, levels of Lookout experience, and variability of sighting conditions, Lookouts will not always be effective at avoiding impacts on all species. However, Lookouts are expected to increase the overall likelihood that certain marine mammal species and some sea turtles will be detected at the surface of the water, when compared to the likelihood that these same species would be detected if Lookouts are not used. The Navy believes the continued use of Lookouts contributes to helping reduce potential impacts on these species from training and testing activities.

5.3.1.2.5 Operational Assessment for Lookouts

As written, implementation of the mitigation measures recommended in Section 5.3.1.2 (Lookouts) has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of military readiness activities, and Navy policy. The number of Lookouts recommended for each measure often represents the maximum Lookout capacity based on limited resources (e.g., space and manning restrictions).

5.3.2 MITIGATION ZONE PROCEDURAL MEASURES

Safety zones described in Section 5.1 (Standard Operating Procedures) are zones designed for human safety, whereas this section will introduce mitigation zones. A mitigation zone is designed solely for the purpose of reducing potential impacts on marine mammals and sea turtles from training and testing activities. Mitigation zones are measured as the radius from a source. Unique to each activity category, each radius represents a distance that the Navy will visually observe to help reduce injury to marine species. Visual detections of applicable marine species will be communicated immediately to the appropriate watch station for information dissemination and appropriate action. If the presence of marine mammals is detected acoustically, Lookouts posted in aircraft and on vessels will increase the vigilance of their visual observation. As a reference, aerial surveys are typically made by flying at 1,500 ft. altitude or lower at the slowest safe speed.

Many of the proposed activities have mitigation measures that are currently being implemented, as required by previous environmental documents or consultations. Most of the current Phase I (e.g., Atlantic Fleet Active Sonar Training EIS/OEIS) mitigation zones for activities that involve the use of impulsive and non-impulsive sources were originally designed to reduce the potential for onset of temporary threshold shift (TTS). For the AFTT EIS/OEIS, the Navy updated the acoustic propagation modeling to incorporate updated hearing threshold metrics (i.e., upper and lower frequency limits), updated density data for marine mammals, and factors such as an animal's likely presence at various depths. An explanation of the acoustic propagation modeling process can be found in the *Determination of Acoustic Effects on Marine Mammals and Sea Turtles for the Atlantic Fleet Training and Testing Environmental Impact Statement/Overseas Environmental Impact Statement* technical report (Marine Species Modeling Team 2013).

As a result of the updates to the acoustic propagation modeling, in some cases the ranges to onset of TTS effects are much larger than those output by previous Phase I models. Due to the ineffectiveness and unacceptable operational impacts associated with mitigating these large areas, the Navy is unable to mitigate for onset of TTS for every activity. In this AFTT analysis, the Navy developed each recommended mitigation zone to avoid or reduce the potential for onset of the lowest level of injury, permanent threshold shift (PTS), out to the predicted maximum range. In some cases where the ranges to effects are smaller than previous models estimated, the mitigation zones were adjusted accordingly to provide consistency across the measures. Mitigating to the predicted maximum range to PTS consequently also mitigates to the predicted maximum range to onset mortality (1 percent mortality), onset slight lung injury, and onset slight gastrointestinal tract injury, since the maximum range to effects for these criteria are shorter than for PTS. Furthermore, in most cases, the predicted maximum range to PTS also consequently covers the predicted average range to TTS. Table 5.3-2 summarizes the predicted average range to TTS, average range to PTS, maximum range to PTS, and recommended mitigation zone for each activity category, based on the Navy's acoustic propagation modeling results.

The activity-specific mitigation zones are based on the longest range for all the functional hearing groups (based on the hearing threshold metrics described in Section 3.4 [Marine Mammals] and Section 3.5 [Sea Turtles and Other Marine Reptiles]). The mitigation zone for a majority of activities is driven by either the high-frequency cetacean or the sea turtle functional hearing groups. Therefore, the mitigation zones are even more protective for the remaining functional hearing groups (i.e., low-frequency cetaceans, mid-frequency cetaceans, and pinnipeds), and likely cover a larger portion of the potential range to onset of TTS.

Table 5.3-2: Predicted Range to Effects and Recommended Mitigation Zones

Activity Category	Representative Source (Bin)[1]	Predicted Average Range to TTS	Predicted Average Range to PTS	Predicted Maximum Range to PTS	Recommended Mitigation Zone
Non-Impulsive Sound					
Low-Frequency and Hull-Mounted Mid-Frequency Active Sonar	SQS-53 ASW hull-mounted sonar (MF1)	3,821 yd. (3.5 km) for one ping	100 yd. (91 m) for one ping	Not Applicable	6 dB power down at 1,000 yd. (914 m); 4 dB power down at 500 yd. (457 m); and shutdown at 200 yd. (183 m)
	Low-frequency sonar[2] (LF4)	3,821 yd. (3.5 km) for one ping	100 yd. (91 m) for one ping	Not Applicable	200 yd. (183 m)[2]
High-Frequency and Non-Hull Mounted Mid-Frequency Active Sonar	AQS-22 ASW dipping sonar (MF4)	230 yd. (210 m) for one ping	20 yd. (18 m) for one ping	Not applicable	200 yd. (183 m)
Explosive and Impulsive Sound					
Improved Extended Echo Ranging Sonobuoys	Explosive sonobuoy (E4)	434 yd. (397 m)	156 yd. (143 m)	563 yd. (515 m)	600 yd. (549 m)
Explosive Sonobuoys Using 0.6–2.5 lb. NEW	Explosive sonobuoy (E3)	290 yd. (265 m)	113 yd. (103 m)	309 yd. (283 m)	350 yd. (320 m)
Anti-Swimmer Grenades	Up to 0.5 lb. NEW (E2)	190 yd. (174 m)	83 yd. (76 m)	182 yd. (167 m)	200 yd. (183 m)
Mine Countermeasure and Neutralization Activities Using Positive Control Firing Devices	NEW dependent (see Table 5.3-3)				
Mine Neutralization Diver-Placed Mines Using Time-Delay Firing Devices	Up to 20 lb. NEW (E6)	647 yd. (592 m)	232 yd. (212 m)	469 yd. (429 m)	1,000 yd. (914 m)
Gunnery Exercises – Small- and Medium-Caliber Using a Surface Target	40 mm projectile (E2)	190 yd. (174 m)	83 yd. (76 m)	182 yd. (167 m)	200 yd. (183 m)
Gunnery Exercises – Large-Caliber Using a Surface Target	5 in. projectiles (E5 at the surface[3])	453 yd. (414 m)	186 yd. (170 m)	526 yd. (481 m)	600 yd. (549 m)

ASW: anti-submarine warfare; dB: decibel; in.: inches: km: kilometer; lb.: pound(s); m: meter; mm: millimeter; NEW: net explosive weight; PTS: permanent threshold shift; TTS: temporary threshold shift; yd.: yard

[1] This table does not provide an inclusive list of source bins; bins presented here represent the source bin with the largest range to effects within the given activity category.

[2] The representative source bin and mitigation zone applies to sources that cannot be powered down (e.g., bins LF4 and LF5).

[3] The representative source bin E5 has different range to effects depending on the depth of activity occurrence (at the surface or at various depths).

Table 5.3-2: Predicted Range to Effects and Recommended Mitigation Zones (Continued)

Activity Category	Representative Source (Bin)[1]	Predicted Average Range to TTS	Predicted Average Range to PTS	Predicted Maximum Range to PTS	Recommended Mitigation Zone
Missile Exercises (Including Rockets) up to 250 lb. NEW Using a Surface Target	Maverick missile (E9)	949 yd. (868 m)	398 yd. (364 m)	699 yd. (639 m)	900 yd. (823 m)
Missile Exercises Using 251–500 lb. NEW Using a Surface Target	Harpoon missile (E10)	1,832 yd. (1.7 km)	731 yd. (668 m)	1,883 yd. (1.7 km)	2,000 yd. (1.8 km)
Bombing Exercises	MK-84 2,000 lb. bomb (E12)	2,513 yd. (2.3 km)	991 yd. (906 m)	2,474 yd. (2.3 km)	2,500 yd. (2.3 km)[2]
Torpedo (Explosive) Testing	MK-48 torpedo (E11)	1,632 yd. (1.5 km)	697 yd. (637 m)	2,021 yd. (1.8 km)	2,100 yd. (1.9 km)
Sinking Exercises	Various sources up to the MK-84 2,000 lb. bomb (E12)	2,513 yd. (2.3 km)	991 yd. (906 m)	2,474 yd. (2.3 km)	2.5 nm[2]
At-Sea Explosive Testing	Various sources of 10 lb. NEW and less (E5 at various depths[3])	525 yd. (480 m)	204 yd. (187 m)	649 yd. (593 m)	1,600 yd. (1.4 km)[2]
Ordnance Testing – Line Charge Testing	Numerous 5-lb. charges (E4)	434 yd. (397 m)	156 yd. (143 m)	563 yd. (515 m)	900 yd. (823 m)[2]
Ship Shock Trials in JAX Range Complex	10,000-lb. charge (HBX)	5.8 nm	2.7 nm	4.8 nm	3.5 nm[4]
	40,000-lb. charge (HBX)	9.2 nm	3.6 nm	6.4 nm	3.5 nm[4]
Ship Shock Trials in VACAPES Range Complex	10,000-lb. charge (HBX)	9 nm	2 nm	4.7 nm	3.5 nm[4]
	40,000-lb. charge (HBX)	10.3 nm	3.7 nm	7.6 nm	3.5 nm[4]
Elevated Causeway System – Pile Driving	24 in. steel impact hammer	1,094 yd. (1 km)	51 yd. (46 m)	51 yd. (46 m)	60 yd. (55 m)

ASW: anti-submarine warfare; HBX: high blast explosive; JAX: Jacksonville; km: kilometer; lb.: pound; m: meter; NEW: net explosive weight; nm: nautical mile; PTS: permanent threshold shift; TTS: temporary threshold shift; VACAPES: Virginia Capes; yd.: yard

[1] This table does not provide an inclusive list of source bins; bins presented here represent the source bin with the largest range to effects within the given activity category.

[2] Recommended mitigation zones are larger than the modeled injury zones to account for multiple types of sources or charges being used.

[3] The representative source bin E5 has different range to effects depending on the depth of activity occurrence (at the surface or at various depths).

[4] See Section 5.3.2.1.2.15 (Ship Shock Trials) regarding ship shock trial mitigation zones.

Table 5.3-3: Predicted Range to Effects and Recommended Mitigation Zones for Mine Countermeasure and Neutralization Activities Using Positive Control Firing Devices

Charge Size Net Explosive Weight (Bins)	General Mine Countermeasure and Neutralization Activities Using Positive Control Firing Devices[1]				Mine Countermeasure and Neutralization Activities Using Diver-Placed Charges Under Positive Control[2]			
	Predicted Average Range to TTS	Predicted Average Range to PTS	Predicted Maximum Range to PTS	Recommended Mitigation Zone	Predicted Average Range to TTS	Predicted Average Range to PTS	Predicted Maximum Range to PTS	Recommended Mitigation Zone
2.6–5 lb. (E4)	434 yd. (474 m)	197 yd. (180 m)	563 yd. (515 m)	600 yd. (549 m)	545 yd. (498 m)	169 yd. (155 m)	301 yd. (275 m)	350 yd. (320 m)
6–10 lb. (E5)	525 yd. (480 m)	204 yd. (187 m)	649 yd. (593 m)	800 yd. (732 m)	587 yd. (537 m)	203 yd. (185 m)	464 yd. (424 m)	500 yd. (457 m)
11–20 lb. (E6)	766 yd. (700 m)	288 yd. (263 m)	648 yd. (593 m)	800 yd. (732 m)	647 yd. (592 m)	232 yd. (212 m)	469 yd. (429 m)	500 yd. (457 m)
21–60 lb. (E7)[3]	1,670 yd. (1.5 km)	581 yd. (531 m)	964 yd. (882 m)	1,200 yd. (1.1 km)	1,532 yd. (1.4 km)	473 yd. (432 m)	789 yd. (721 m)	800 yd. (732 m)
61–100 lb. (E8)[4]	878 yd. (802 m)	383 yd. (351 m)	996 yd. (911 m)	1,600 yd. (1.4 km)	969 yd. (886 m)	438 yd. (400 m)	850 yd. (777 m)	850 yd. (777 m)
251–500 lb. (E10)	1,832 yd. (1.7 km)	731 yd. (668 m)	1,883 yd. (1.7 km)	2,000 yd. (1.8 km)				Not Applicable
501–650 lb. (E11)	1,632 yd. (1.5 km)	697 yd. (637 m)	2,021 yd. (1.8 km)	2,100 yd. (1.9 km)				Not Applicable

km: kilometer; lb.: pound; m: meter; PTS: permanent threshold shift; TTS: temporary threshold shift; yd.: yard
[1] These mitigation zones are applicable to all mine countermeasure and neutralization activities conducted in all locations specified in Tables 2.8-1 through 2.8-3.
[2] These mitigation zones are only applicable to mine countermeasure and neutralization activities involving the use of diver-placed charges. These activities are conducted in shallow water, and the mitigation zones are based only on the functional hearing groups with species that occur in these areas (mid-frequency cetaceans and sea turtles).
[3] The E7 bin was only modeled in shallow-water locations, so there is no difference for the diver-placed charges category.
[4] The E8 bin was only modeled for surface explosions, so some of the ranges are shorter than for sources modeled in the E7 bin, which occur at depth.

In some instances, the Navy recommends mitigation zones that are larger or smaller than the predicted maximum range to PTS based on the effectiveness and operational assessments. The recommended mitigation zones and their associated assessments are provided throughout the remainder of this section. The recommended measures are either currently implemented, modifications of current measures, or new measures.

For some activities specified throughout the remainder of this section, Lookouts may be required to observe for concentrations of detached floating vegetation (*Sargassum* or kelp paddies), which are indicators of potential marine mammal and sea turtle presence, within the mitigation zone. Those specified activities will not commence if the floating vegetation (*Sargassum* or kelp paddies) is observed within the mitigation zone prior to the initial start of the activity. If floating vegetation is observed prior to the initial start of the activity, the activity will be relocated to an area where no floating vegetation is observed. Training and testing will not cease as a result of floating vegetation (*Sargassum* or kelp paddies) entering the mitigation zone after activities have commenced. This measure is intended only for floating vegetation detached from the seafloor.

5.3.2.1 Acoustic Stressors

5.3.2.1.1 Non-Impulsive Sound

5.3.2.1.1.1 Low-Frequency and Hull-Mounted Mid-Frequency Active Sonar

Recommended Mitigation and Comparison to Current Mitigation

Mitigation measures do not currently exist for low-frequency active sonar sources analyzed in this Final EIS/OEIS, or new platforms or systems. The Navy is proposing to (1) add mitigation measures for low-frequency active sonar, (2) continue implementing the current measures for mid-frequency active sonar, and (3) clarify the conditions needed to recommence an activity after a sighting. The recommended measures are provided below.

Training and testing activities that involve the use of low-frequency and hull-mounted mid-frequency active sonar (including pierside) will use Lookouts for visual observation from a ship immediately before and during the activity. Active sonar transmission will not begin if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone. With the exception of certain low-frequency sources that are not able to be powered down during the activity (e.g., low-frequency sources within bins LF4 and LF5), mitigation will involve powering down the sonar by 6 dB when a marine mammal or sea turtle (low-frequency sources only) is sighted within 1,000 yd. (914 m), and by an additional 4 dB when sighted within 500 yd. (457 m) from the source, for a total reduction of 10 dB. If the source can be turned off during the activity, active transmission will cease if a marine mammal or sea turtle (low-frequency sources only) is sighted within 200 yd. (183 m). Active transmission will recommence if any one of the following conditions is 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 and speed and the relative motion between the animal and the source, (3) the mitigation zone has been clear from any additional sightings for a period of 30 min., (4) the ship has transited more than 2,000 yd. (1.8 kilometers [km]) beyond the location of the last sighting, or (5) the ship concludes that dolphins are deliberately closing in on the ship to ride the ship’s bow wave (and there are no other marine mammal sightings within the mitigation zone). Active transmission may resume when dolphins are bow riding because they are out of the main transmission axis of the active sonar while in the shallow-wave area of the bow.

If the source is not able to be powered down during the activity (e.g., low-frequency sources within bins LF4 and LF5), mitigation will involve ceasing active transmission if a marine mammal or sea turtle is sighted within 200 yd. (183 m). Active transmission will recommence if any one of the following conditions is 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 and speed and the relative motion between the animal and the source, (3) the mitigation zone has been clear from any additional sightings for a period of 30 min., or (4) the ship has transited more than 400 yd. (366 m) beyond the location of the last sighting.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential impacts they are designed to reduce. As shown in Table 5.3-2, the predicted average range to onset of PTS for low-frequency and hull-mounted mid-frequency active sonar sources is 100 yd. (91 m) for one ping. This range was determined by the high-frequency cetacean functional hearing group. The distance for all other marine mammal functional hearing groups is less than 80 yd. (73 m) for one ping, so the mitigation zone will provide further protection from injury (PTS) for these species. Therefore, implementation of the 200 yd. (183 m) shutdown zone will reduce the potential for exposure to higher levels of energy that would result in injury (PTS) and large threshold shifts that are recoverable (i.e., TTS) when individuals are sighted. Implementation of the 500 yd. (457 m) and 1,000 yd. (914 m) sonar power reductions will further reduce the potential for injury (PTS) and larger threshold shifts that would result in recovery (i.e., TTS) to occur when individual marine mammals are sighted within these zones, especially in cases where the ship and animal are approaching each other.

The mitigation zones the Navy has developed are within a range for which Lookouts can reasonably be expected to maintain situational awareness and visually observe during most conditions. Since the predicted average range to onset of TTS is 3,821 yd. (3.5 km), the entire range to TTS is not reasonably observable. By establishing mitigation zones that can be realistically maintained from ships, Lookouts will be more effective at sighting individual animals. By keeping Lookouts focused within the ranges where exposure to higher levels of energy is possible, the effectiveness at reducing potential impacts on marine mammals and sea turtles will increase. As discussed in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), the likelihood of sighting individual animals, particularly sea turtles and some species of small or cryptic marine mammals, decreases at long distances. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [*Sargassum* or kelp paddies]) will further help avoid impacts on marine mammals and sea turtles. Observations for sea turtles are required only during low-frequency active sonar activities because hull-mounted mid-frequency active sonars are not within the primary sea turtle hearing range.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30-min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.4.3.1.8 (Impacts from Sonar and Other Active Acoustic Sources) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur. Requiring additional delay beyond 30 min. would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would eliminate opportunities to detect submarines, objects, or other exercise targets as would be required in a real world combat situation; reduce the sonar operator's situational awareness of the environment where the training or testing is occurring; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.1.2 High-Frequency and Non-Hull Mounted Mid-Frequency Active Sonar

Recommended Mitigation and Comparison to Current Mitigation

Mitigation measures do not currently exist for all high-frequency and non-hull mounted mid-frequency active sonar activities (i.e., new sources or sources not previously analyzed). The Navy is proposing to (1) continue implementing the current mitigation measures for activities currently being executed, such as dipping sonar activities, (2) extend the implementation of its current mitigation to all other activities in this category, and (3) clarify the conditions needed to recommence an activity after a sighting. The recommended measures are provided below.

Mitigation will include visual observation from a vessel or aircraft (with the exception of platforms operating at high altitudes) immediately before and during active transmission within a mitigation zone of 200 yd. (183 m) from the active sonar source. For activities involving helicopter-deployed dipping sonar, visual observation will commence 10 min. before the first deployment of active dipping sonar. Helicopter dipping and sonobuoy deployment will not begin if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone. If the source can be turned off during the activity, active transmission will cease if a marine mammal or sea turtle (for MF8, MF9, MF10, and MF12 only) is sighted within the mitigation zone. Active transmission will recommence if any one of the following conditions is 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 and speed and the relative motion between the animal and the source, (3) the mitigation zone has been clear from any additional sightings for a period of 10 min. for an aircraft-deployed source, (4) the mitigation zone has been clear from any additional sightings for a period of 30 min. for a vessel-deployed source, (5) the vessel or aircraft has repositioned itself more than 400 yd. (366 m) away from the location of the last sighting, or (6) the vessel concludes that dolphins are deliberately closing in to ride the vessel's bow wave (and there are no other marine mammal sightings within the mitigation zone).

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential impacts they are designed to reduce. As shown in Table 5.3-2, the predicted average range to onset of PTS for high-frequency and non-hull mounted mid-frequency active sonar sources is 20 yd. (18 m) for one ping. This range was determined by the high-frequency cetacean functional hearing group. The average range to onset of TTS across all functional hearing groups is 230 yd. (210 m) for one ping. Implementation of the 200-yd. (183-m) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury (PTS) and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted. Lookouts often visually observe either close aboard a vessel or from directly above the source by aircraft (i.e., helicopters). Exceptions include when sonobuoys are deployed and when sources are deployed from high altitude aircraft. When sonobuoys are used, the sonobuoy field may be dispersed over a large distance. As discussed in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), the likelihood of sighting individual animals, particularly sea turtles and some species of small or cryptic marine mammals decreases at long distances. This measure should be effective at reducing risks to all marine mammals and sea turtles that are available to be observed within the mitigation zone. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [*Sargassum* or kelp paddies]) will further help avoid impacts on marine mammals and sea turtles. Observations for sea turtles are required only during non-hull mounted mid-frequency active sonar activities within bins MF8, MF9, MF10, and MF12 because high-frequency active sonars and other bins of mid-frequency sonar are not within the primary sea turtle hearing range.

The post-sighting wait periods are designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. The 30-min. wait period for vessel-deployed sources more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving species. However, the analysis in Section 3.4.3.1.8 (Impacts from Sonar and Other Active Acoustic Sources) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur, with the exception of *Kogia* species. Requiring additional delay beyond 30 min. for vessel-deployed sources would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would eliminate opportunities to detect submarines, objects, or other exercise targets and would be required during a real world combat situation; reduce the sonar operator's situational awareness of the environment where the training or testing is occurring; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The 10-min. wait period for aircraft-deployed sources covers a portion of the average marine mammal and sea turtle dive times but may not be sufficient to cover the average dive times of all species. The 10-min. wait period for aircraft-deployed sources is based on fuel restrictions for the types of aircraft involved in this activity (e.g., helicopters). Requiring additional delay beyond 10 min. for these sources would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would result in an unacceptable increased risk to personnel safety or would require aircraft to depart the activity location to refuel, which would eliminate opportunities to detect submarines, objects, or other exercise targets as would be required during a real world combat situation; reduce the sonar operator's situational awareness of the environment where the training or testing is occurring; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2 Explosives and Impulsive Sound

5.3.2.1.2.1 Improved Extended Echo Ranging Sonobuoys

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to (1) modify the mitigation measures currently implemented for this activity by reducing the marine mammal and sea turtle mitigation zone from 1,000 yd. (914 m) to 600 yd. (549 m), (2) clarify the conditions needed to recommence an activity after a sighting, and (3) adopt the marine mammal and sea turtle mitigation zone size for floating vegetation for ease of implementation. The recommended measures are provided below.

Mitigation will include pre-exercise aerial observation and passive acoustic monitoring, which will begin 30 min. before the first source/receiver pair detonation and continue throughout the duration of the exercise within a mitigation zone of 600 yd. (549 m) around an Improved Extended Echo Ranging sonobuoy. The pre-exercise aerial observation will include the time it takes to deploy the sonobuoy pattern (deployment is conducted by aircraft dropping sonobuoys in the water). Improved Extended Echo Ranging sonobuoys will not be deployed if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone around the intended deployment location. Explosive detonations will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Detonations will recommence if any one of the following conditions is 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 and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 min.

Passive acoustic monitoring would be conducted with Navy assets, such as sonobuoys, already participating in the activity. These assets would only detect vocalizing marine mammals within the frequency bands monitored by Navy personnel. Passive acoustic detections would not provide range or bearing to detected animals, and therefore cannot provide locations of these animals. Passive acoustic detections would be reported to Lookouts posted in aircraft and on vessels in order to increase vigilance of their visual observation.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential impacts they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for Improved Extended Echo Ranging sonobuoys is 563 yd. (515 m). This range was determined by the high-frequency cetacean functional hearing group. The remaining functional hearing groups had a shorter range to onset of PTS, so the mitigation zone will provide further protection for these species. The average range to onset of TTS across all functional hearing groups is 434 yd. (397 m). Implementation of the 600-yd. (549-m) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted. The sonobuoy field may be dispersed over a large distance. As discussed in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), the likelihood of sighting individual animals, particularly sea turtles and some species of small or cryptic marine mammals, decreases at long distances. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [*Sargassum* or kelp paddies]) will further help avoid impacts on marine mammals and sea turtles.

The decrease in mitigation zone size will result in no mitigation for exposure to lower levels of potential onset of TTS; however, it will allow for a more focused survey effort over a smaller survey distance, and will consequently increase the likelihood of avoidance of injury and larger threshold shifts that would result in recovery (i.e., TTS) to marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30-min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.4.3.1.9 (Impacts from Explosives) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur. Requiring additional delay beyond 30 min. for aircraft-deployed Improved Extended Echo Ranging sonobuoys would modify the activity in a way that it would no longer meet its intended objective. The 30-min. wait period represents the maximum wait period acceptable for the type of aircraft involved in this activity (e.g., maritime patrol aircraft) based on fuel restrictions. Any additional delay would result in an unacceptable increased risk to personnel safety, require aircraft to depart the activity location to refuel, eliminate opportunities to detect submarines as would be required in a real world combat situation; and reduce the aircrew's situational awareness of the environment where the activity is occurring; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.2 Explosive Sonobuoys Using 0.6–2.5 Pound Net Explosive Weight

Recommended Mitigation and Comparison to Current Mitigation

Mitigation measures do not currently exist for this activity. The Navy is proposing to add the recommended measures provided below.

Mitigation will include pre-exercise aerial monitoring during deployment of the field of sonobuoy pairs (typically up to 20 min.) and continue throughout the duration of the exercise within a mitigation zone of 350 yd. (320 m) around an explosive sonobuoy. Explosive sonobuoys will not be deployed if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone (around the intended deployment location). Explosive detonations will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Detonations will recommence if any one of the following conditions is 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 and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 min.

Passive acoustic monitoring will also be conducted with Navy assets, such as sonobuoys, already participating in the activity. These assets would only detect vocalizing marine mammals within the frequency bands monitored by Navy personnel. Passive acoustic detections would not provide range or bearing to detected animals, and therefore cannot provide locations of these animals. Passive acoustic detections would be reported to Lookouts posted in aircraft in order to increase vigilance of their visual observation.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential impacts they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for explosive sonobuoys using 0.6–2.5 lb. net explosive weight is 309 yd. (283 m). This range was determined by the high-frequency cetacean functional hearing group. The remaining functional hearing groups had a shorter range to onset of PTS, so the mitigation zone will provide further protection for these species. The average range to onset of TTS across all functional hearing groups is 290 yd. (265 m). Implementation of the 350-yd. (320-m) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and large threshold shifts that are recoverable (i.e., TTS) when individuals are sighted. The sonobuoy field may be dispersed over a large distance. As discussed in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), the likelihood of sighting individual animals, particularly sea turtles and some species of small or cryptic marine mammals, decreases at long distances.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 10-min. wait period covers a portion of the average marine mammal and sea turtle dive times but may not be sufficient to cover the average dive times of all species. The 10-min. wait period for aircraft-deployed sources is based on fuel restrictions for the types of aircraft involved in this activity (e.g., helicopters). Requiring additional delay beyond 10 min. for these sources would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would result in an unacceptable increased risk to personnel safety or would require aircraft to depart the activity location to refuel, which would eliminate opportunities to detect and track submarines or other exercise targets as would be required in a real world combat situation; reduce the sonar operator's situational awareness of the environment where the training or testing is occurring; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.3 Anti-Swimmer Grenades

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to (1) continue implementing the current mitigation measures for this activity, and (2) clarify the conditions needed to recommence an activity after a sighting. The recommended measures are provided below.

Mitigation will include visual observation from a small boat immediately before and during the exercise within a mitigation zone of 200 yd. (183 m) around an anti-swimmer grenade. The exercise will not commence if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone. Explosive detonations will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Detonations will recommence if any one of the following conditions is 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 and speed and the relative motion between the animal and the source, (3) the mitigation zone has been clear from any additional sightings for a period of 30 min., or (4) the activity has been repositioned more than 400 yd. (366 m) away from the location of the last sighting.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential impacts they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for anti-swimmer grenades is 182 yd. (167 m). This range was determined by the high-frequency cetacean functional hearing group. The remaining functional hearing groups had a shorter range to onset of PTS, so the mitigation zone will provide further protection for these species. The average range to onset of TTS across all functional hearing groups is 190 yd. (174 m). Implementation of the 200-yd. (183-m) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted. Since the Lookout is visually observing close aboard the boat, this measure should be effective at reducing the risk to all marine mammals and sea turtles that are available to be observed. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [*Sargassum* or kelp paddies]) will further help avoid impacts on marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30-min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.4.3.1.9 (Impacts from Explosives) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur. Requiring additional delay beyond 30 min. would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would eliminate opportunities for maritime security forces to detect, respond to, and defend against enemy scuba divers as would be required in a real world combat situation; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.4 Mine Countermeasure and Neutralization Activities Using Positive Control Firing Devices

Recommended Mitigation and Comparison to Current Mitigation

As background, mine countermeasure and neutralization activities can be divided into two main categories: (1) general activities that can be conducted from a variety of platforms and locations, and (2) activities involving the use of diver-placed charges that typically occur close to shore. When either of these activities are conducted using a positive control firing device, the detonation is controlled by the personnel conducting the activity and is not authorized until the area is clear at the time of detonation. Refer to Section 5.3.3.2.1.1 (Shallow Coral Reefs, Hard Bottom Habitat, Artificial Reefs, and Shipwrecks) for information on mitigation designed to avoid or reduce potential impacts from military expended materials within shallow coral reef, live hard bottom, artificial reef, and shipwreck mitigation areas.

For general mine countermeasure and neutralization activities, the Navy is proposing to (1) modify the currently implemented mitigation measures to account for additional categories of net explosive weights and to align with the modeled explosive bins, (2) clarify the conditions needed to recommence an activity after a sighting, and (3) add a requirement to observe for floating vegetation. For comparison, the currently implemented mitigation zones for general mine countermeasure and neutralization are 378 yd. (345 m) when using less than 11 lb. net explosive weight; 1,091 yd. (997 m) when using 11–75 lb. net explosive weight; and 3,130 yd. (2.9 km) when using 76–600 lb. net explosive weight. The recommended general mine countermeasure and neutralization measures are provided below.

The Navy is proposing to use the mitigation zones outlined in Table 5.3-3 during general mine countermeasure activities using positive control firing devices. General mine countermeasure and neutralization activity mitigation will include visual observation from small boats or aircraft beginning 10 min. before, during, and 10 min. after (when helicopters are involved in the activity) or 30 min. before, during, and 30 min. after (when helicopters are not involved in the activity) the completion of the exercise within the mitigation zones around the detonation site. For activities involving explosives in bin E11 (501–650 lb. net explosive weight), aerial observation of the mitigation zone will be conducted. The exercise will not commence if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone. Explosive detonations will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Detonations will recommence if any one of the following conditions is 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 and speed and the relative motion between the animal and the source, (3) the mitigation zone has been clear from any additional sightings for a period of 10 min. when helicopters are involved in the activity, or (4) the mitigation zone has been clear from any additional sightings for a period of 30 min when helicopters are not involved in the activity.

For activities involving positive control diver-placed charges, the Navy is proposing to (1) add new mitigation measures for mine neutralization activities involving diver-placed charges using 21–100 lb. net explosive weight charges, (2) modify the currently implemented mitigation measures for activities involving diver-placed charges using less than or equal to 20 lb. net explosive weight charges to account for additional categories of net explosive weights and to align with the modeled explosive bins, (3) discontinue implementing the addition of a Lookout to observe for hatchling sea turtles from late July through October, (4) clarify the conditions needed to recommence an activity after a sighting, and (5) add a requirement to observe for floating vegetation. For comparison, the currently implemented mitigation zone for less than or equal to 20 lb. net explosive weight charges is 700 yd. (640 m). The recommended measures for activities involving positive control diver-placed activities are provided below.

The Navy is proposing to use the mitigation zones outlined in Table 5.3-3 during activities involving positive control diver-placed charges. Visual observation will be conducted by either two small boats or by one small boat and one helicopter. Boats will position themselves near the mid-point of the mitigation zone radius (but always outside the detonation plume radius and human safety zone) and travel in a circular pattern around the detonation location. When using two boats, each boat will be positioned on opposite sides of the detonation location, separated by 180 degrees. If used, helicopters will travel in a circular pattern around the detonation location. The conditions needed to recommence an activity after a sighting and requirement to observe for floating vegetation recommended above for general mine countermeasure and neutralization activities above will also apply to activities using diver-placed charges.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential impacts they are designed to reduce. The range to effects shown in Table 5.3-3 for general mine countermeasure and neutralization activities using positive control firing devices were determined by the high-frequency cetacean functional hearing group. The remaining functional hearing groups had shorter ranges to onset of PTS, so the mitigation zones will provide further protection for these species. Implementation of the mitigation zones outlined in Table 5.3-3 will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted.

As described in Section 5.3.1 (Lookout Procedural Measures), Lookouts positioned in aircraft or small boats may be responsible for tasks in addition to observing the air or surface of the water. For example, a Lookout for this activity may also be responsible for navigation or assistance with mine countermeasure and neutralization deployment. The decrease in mitigation zone size for activities using diver-placed charges will result in no mitigation for exposure to lower levels of potential onset of TTS;

however, it will allow for a more focused survey effort over a smaller area, and will consequently increase the likelihood of avoidance of injury and larger threshold shifts that would result in recovery (i.e., TTS) to marine mammals. Having a Lookout observe a mitigation zone that is too large could potentially increase the safety risk due to an increased level of distraction from normal job duties. Observation of an area beyond what the Navy is proposing to implement would not be likely to result in avoidance or reduction of injury to marine mammals or sea turtles because the effort spent observing those more distant areas would inevitably be minimal.

As described in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), the ability of a Lookout to detect an animal can vary greatly based on what observing platform is being used. For large ranges, aerial observation is more effective. In addition, when observing from a small boat, sea turtle and cryptic marine mammal species can be very difficult to detect beyond a few meters. However, this measure should be effective at reducing potential impacts for individuals that are sighted.

Mine neutralization activities involving diver-placed charges occur primarily close to shore and in shallow water (concentrated in the Virginia Capes [VACAPES] Range Complex) where only mid-frequency cetaceans and sea turtles are expected to occur with any regularity. The range to effects shown in Table 5.3-3 for mine neutralization activities involving diver-placed charges under positive control were determined by the sea turtle functional hearing group. The mid-frequency hearing group had shorter ranges to onset of PTS, so the mitigation zones will provide further protection for these species. However, mitigation would be implemented for any species observed within the mitigation zone. Implementation of the mitigation zones outlined in Table 5.3-3 will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted. The decrease in mitigation zone size for activities using diver-placed charges (up to 20 lb. net explosive weight) will result in no mitigation for exposure to lower levels of potential onset of TTS; however, it will allow for a more focused survey effort over a smaller area, and will consequently increase the likelihood of avoidance of injury and larger threshold shifts that would result in recovery (i.e., TTS) to marine mammals.

During activities using diver-placed charges, Lookouts are visually observing from small boats or helicopters. As discussed above, aerial observation is more effective than observation from a small boat. Since small boats do not have a very elevated observing platform, the distance over which animals can be observed is much shorter. Sea turtles and cryptic marine mammal species would be very difficult to detect further than a few meters away from the boat. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [*Sargassum* or kelp paddies]) will further help avoid impacts on marine mammals and sea turtles.

For activities using diver-placed charges, maintaining an additional Lookout to observe for hatchling sea turtles is impractical to implement from an operational standpoint due to the unacceptable impact on resource requirements (i.e., limited personnel resources), and does not effectively reduce the potential for impacts on sea turtles to occur due to the extreme difficulty of sighting hatchlings at sea (see Section 5.3.1.2.4, Effectiveness Assessment for Lookouts). See Section 5.3.3.3.1.2 (Sea Turtle Nesting Habitat off North Carolina) and Section 5.3.3.4.1.1 (Piping Plover Breeding Habitat in Virginia) for information on mitigation areas pertinent to these activities.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30-min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.4.3.1.9 (Impacts from Explosives) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur. Requiring additional delay beyond 30 min. (when helicopters are not involved in the activity) would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would eliminate opportunities to detect, identify, evaluate, and neutralize mines as would be required in a real world combat situation; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The 10-min. wait period (when helicopters are involved in the activity) covers a portion of the average marine mammal and sea turtle dive times but may not be sufficient to cover the average dive times of all species. The 10-min. wait period is based on helicopter fuel restrictions. Requiring additional delay beyond 10 min. for these sources would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would result in an unacceptable increased risk to personnel safety or would require aircraft to depart the activity location to refuel, which would eliminate opportunities to detect, identify, evaluate, and neutralize mines; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of injury to most marine mammal species; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.5 Mine Neutralization Activities Using Diver-Placed Time-Delay Firing Devices

Recommended Mitigation and Comparison to Current Mitigation

As background, when mine neutralization activities using diver-placed charges (up to a 20 lb. net explosive weight) are conducted with a time-delay firing device, 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. During these activities, the detonation cannot be terminated once the fuse is initiated due to human safety concerns. Refer to Section 5.3.2.1.2.4 (Mine Countermeasure and Neutralization Activities Using Positive Control Firing Devices) for a general discussion of mitigation measures applicable to mine neutralization activities using diver-placed mines. This section will specify unique mitigation zones and observation methods for diver-placed mine activities that use time-delay firing devices. Refer to Section 5.3.3.2.1.1 (Shallow Coral Reefs, Hard Bottom Habitat, Artificial Reefs, and Shipwrecks) for information on mitigation designed to avoid or reduce potential impacts from military expended materials within shallow coral reef, live hard bottom, artificial reef, and shipwreck mitigation areas.

The Navy is proposing to (1) modify the mitigation zones and observation requirements currently implemented for mine countermeasure and neutralization activities using diver-placed time-delay firing devices, (2) clarify the conditions needed to recommence an activity after a sighting, and (3) add a requirement to observe for floating vegetation. For comparison, the current mitigation zones are based on size of charge and length of time-delay, ranging from a 1,000-yd. (914-m) mitigation zone for a 5 lb. net explosive weight charge using a 5-min. time-delay to a 1,450-yd. (1,326-m) mitigation zone for a 20 lb. net explosive weight charge using a 10-min. time-delay. The current requirement is for two small boats to be used for observation in mitigation zones that are less than 1,400 yd. (1,280 m). The recommended measures for activities involving diver-placed time-delay firing devices are provided below.

The Navy recommends one mitigation zone for all net explosive weights and lengths of time-delay. Mine neutralization activities involving diver-placed charges will not include time-delay longer than 10 min. Mitigation will include visual observation from small boats commencing 30 min. before, during, and until 30 min. after the completion of the exercise within a mitigation zone of 1,000 yd. (915 m) around the detonation site. During activities using time-delay firing devices involving up to a 20 lb. net explosive weight charge, visual observation will take place using two small boats. In addition, when aircraft are involved (e.g., during deployment of divers), the pilot or member of the aircrew will serve as an additional Lookout. The exercise will not commence if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone. The fuse initiation will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Fuse initiation will recommence if any one of the following conditions is 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 and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 min.

Survey boats will position themselves near the mid-point of the mitigation zone radius (but always outside the detonation plume radius/human safety zone) and travel in a circular pattern around the detonation location. One Lookout from each boat will look inward toward the detonation site and the other Lookout will look outward away from the detonation site. Each boat will be positioned on opposite sides of the detonation location, separated by 180 degrees. If participating, helicopters will travel in a circular pattern around the detonation location.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential impacts they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for mine neutralization diver-placed mines using time-delay firing devices is 469 yd. (429 m). This range was determined by the high-frequency cetacean functional hearing group. The remaining functional hearing groups had a shorter range to onset of PTS, so the mitigation zone will provide further protection for these species. The average range to onset of TTS across all functional hearing groups is 647 yd. (592 m). The time-delay firing device mitigation zone was determined by including additional distance on top of the predicted maximum range to onset of PTS to account for a portion of the time that a marine mammal or sea turtle could enter the mitigation zone during the time-delay. Implementation of the 1,000-yd. (915-m) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted.

A 1,000-yd. (915-m) mitigation zone represents the maximum distance that the Lookouts on small boats can adequately observe given the number of personnel that will be involved. As discussed in Section 5.3.1.2.2.5 (Mine Neutralization Activities Using Diver-Placed Time-Delay Firing Devices), the use of more than two small boats for observation during this activity presents an unacceptable impact on readiness due to limited personnel resources. Since small boats do not have an elevated observing platform, the distance over which animals can be observed is much shorter. Sea turtles and cryptic marine mammal species would be very difficult to detect further than a few meters away from the boat. Sighting a sea turtle is only likely if a helicopter is participating in the activity. In addition, even with the extended mitigation zone to account for as much of the time-delay as possible, there is still a remote chance that animals may swim into the area after the charge is already set. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [*Sargassum* or kelp paddies]) will further help avoid impacts on marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30-min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.4.3.1.9 (Impacts from Explosives) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur. The 30-min. wait period covers a portion of the average marine mammal and sea turtle dive times but may not be sufficient to cover the average dive times of all species. Requiring additional delay beyond 30 min. would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would eliminate opportunities to detect, identify, evaluate, and neutralize mines as would be required in a real world combat situation; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The Navy proposes implementing the recommended measures described above because (1) they are likely to result in avoidance or reduction of injury to most marine mammal species; and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.6 Gunnery Exercises – Small- and Medium-Caliber Using a Surface Target

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to (1) continue implementing the current mitigation measures for this activity, (2) clarify the conditions needed to recommence an activity after a sighting, and (3) add a requirement to visually observe for kelp paddies. Refer to Section 5.3.3.2.1.1 (Shallow Coral Reefs, Hard Bottom Habitat, Artificial Reefs, and Shipwrecks) for information on mitigation designed to avoid or reduce potential impacts from military expended materials within shallow coral reef mitigation areas. The recommended measures are provided below.

Mitigation will include visual observation from a vessel or aircraft immediately before and during the exercise within a mitigation zone of 200 yd. (183 m) around the intended impact location. Vessels will observe the mitigation zone from the firing position. When aircraft are firing, the aircrew will maintain visual watch of the mitigation zone during the activity. The exercise will not commence if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is 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 and speed and the relative motion between the animal and the source, (3) the mitigation zone has been clear from any additional sightings for a period of 10 min. for a firing aircraft, (4) the mitigation zone has been clear from any additional sightings for a period of 30 min. for a firing vessel, and (5) the intended target location has been repositioned more than 400 yd. (366 m) away from the location of the last sighting.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential impacts they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for small- and medium-caliber gunnery is 182 yd. (167 m). This range was determined by the high-frequency cetacean functional hearing group. The remaining functional hearing groups had a shorter range to onset of PTS, so the mitigation zone will provide further protection for these species. The average range to onset of TTS across all functional hearing groups is 190 yd. (174 m). Implementation of the 200-yd. (183-m) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted.

Small- and medium-caliber gunnery exercises involve the participating vessel or aircraft firing munitions at a target location that may be up to 4,000 yd. (3.7 km) away, although typically much closer than this. Therefore, it is necessary for the Lookout to be able to visually observe the mitigation zone from varying distances. Large vessel or aircraft platforms would provide a more effective observation platform for Lookouts than small boats. However, as discussed in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), it is highly unlikely that anything but a whale blow or large pod of dolphins will be seen at distances closer to 4,000 yd. (3.7 km). However, this measure is likely effective at reducing the risk of injury to marine mammals that may be observed from the typical target distances. This measure may be ineffective at reducing the risk of injury to sea turtles at large target distances; however, it does reduce the risk for those individuals that may be observed at closer distances. In addition, it is more likely that sea turtles will be observed when exercises involve aircraft versus vessels. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [*Sargassum* or kelp paddies]) will further help avoid impacts on marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. The 30-min. wait period for a firing vessel more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.4.3.1.9 (Impacts from Explosives) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur. Requiring additional delay beyond 30 min. for a firing vessel would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would reduce the gun crews' abilities to engage surface targets and practice defensive marksmanship as would be required in a real world combat situation and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The 10-min. wait period for a firing aircraft covers a portion of the average marine mammal and sea turtle dive times but may not be sufficient to cover the average dive times of all species. The 10-min. wait period is based on fuel restrictions for the types of aircraft involved in this activity (e.g., helicopters). Requiring additional delay beyond 10 min. for these sources would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would result in an unacceptable increased risk to personnel safety or would require aircraft to depart the activity location to refuel, which would eliminate opportunities and reduce the gun crews' abilities to engage surface targets and practice defensive marksmanship as would be required in a real world combat situation; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to some marine mammal species, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.7 Gunnery Exercises – Large-Caliber Using a Surface Target

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to (1) continue using the currently implemented mitigation zone for this activity, (2) clarify the conditions needed to recommence an activity after a sighting, (3) add a requirement to visually observe for kelp paddies, (4) modify the seafloor habitat mitigation area, and (5) specifically for activities involving the integrated maritime portable acoustic scoring system, decrease the post-sighting activity recommencement wait period from 45 min. to 30 min. and remove the requirement for post-activity visual observations of the mitigation zone during buoy retrieval. Refer to Section 5.3.3.2.1.1 (Shallow Coral Reefs, Hard Bottom Habitat, Artificial Reefs, and Shipwrecks) for information on mitigation designed to avoid or reduce potential impacts from military expended materials within shallow coral reef mitigation areas. The recommended measures are provided below.

Mitigation will include visual observation from a ship immediately before and during the exercise within a mitigation zone of 600 yd. (549 m) around the intended impact location. Ships will observe the mitigation zone from the firing position. The exercise will not commence if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is 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 and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 min.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential impacts they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for large-caliber gunnery is 526 yd. (481 m). This range was determined by the high-frequency cetacean functional hearing group. The remaining functional hearing groups had a shorter range to onset of PTS, so the mitigation zone will provide further protection for these species. The average range to onset of TTS across all functional hearing groups is 453 yd. (414 m). Implementation of the 600-yd. (549-m) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted. Eliminating the post-activity visual observations for activities that use the integrated maritime portable acoustic scoring system will help maintain consistency between large-caliber gunnery exercises using a surface target and improve the practicality of implementation. Per the Navy's current reporting requirements, any injured or dead marine mammals or sea turtles will be reported as appropriate.

Large-caliber gunnery exercises involve the participating ship firing munitions at a target location from ranges up to 6 nm away. Therefore it is necessary for the Lookout to be able to visually observe the mitigation zone from this distance. Although the Lookout will observe for all marine mammals or sea turtles in the area, as discussed in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), it is highly unlikely that anything but a whale blow or large pod of dolphins will be seen. Although this measure is likely ineffective at reducing the risk of injury to sea turtles and some species of marine mammals, it does reduce the risk for those individuals that may be observed. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [*Sargassum* or kelp paddies]) will further help avoid impacts on marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30-min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.4.3.1.9 (Impacts from Explosives) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur. Requiring additional delay beyond 30 min. would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would reduce the gun crews' abilities to engage surface targets and practice defensive marksmanship as would be required in a real world combat situation; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to some marine mammal species, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.8 Missile Exercises (Including Rockets) up to 250 Pound Net Explosive Weight Using a Surface Target

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to (1) modify the mitigation measures currently implemented for this activity by reducing the mitigation zone from 1,800 yd. (1.6 km) to 900 yd. (823 m), (2) clarify the conditions needed to recommence an activity after a sighting, (3) adopt the marine mammal and sea turtle mitigation zone size for floating vegetation for ease of implementation, and (4) modify the platform of observation to eliminate the requirement to observe when ships are firing. Refer to Section 5.3.3.2.1.1 (Shallow Coral Reefs, Hard Bottom Habitat, Artificial Reefs, and Shipwrecks) for information on mitigation designed to avoid or reduce potential impacts from military expended materials within shallow coral reef mitigation areas. The recommended measures are provided below.

When aircraft are firing, mitigation will include visual observation by the aircrew or supporting aircraft prior to commencement of the activity within a mitigation zone of 900 yd. (823 m) around the deployed target. The exercise will not commence if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is 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 and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 min. or 30 min. (depending on aircraft type).

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential impacts they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for a missile exercise (including rockets) up to 250 lb. net explosive weight (bin E9) is 699 yd. (639 m). This range was determined by the sea turtle functional hearing group. The marine mammal functional hearing groups had a shorter range to onset of PTS, so the mitigation zone will provide further protection for these species. The average range to onset of TTS across all functional hearing groups is 949 yd. (868 m). Implementation of the 900-yd. (823-m) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted. The decrease in mitigation zone size will result in no mitigation for exposure to lower levels of potential onset of TTS; however, it will allow for a more focused survey effort over a smaller survey distance, and will consequently increase the likelihood of avoidance of injury and larger threshold shifts that would result in recovery (i.e., TTS) to marine mammals and sea turtles.

Missile exercises involve the participating ship or aircraft firing munitions at a target location typically up to 15 nm away and infrequently include ranges up to 75 nm away. When an aircraft is firing, the aircraft can travel close to the intended impact area so that it can be visually observed. Because that type of observation is not possible for a ship, visual observation is not suitable for activities that involve a ship-fired missile. Even with aircraft firing, there is a chance that animals could enter the impact area after the visual observations have been completed and the activity has commenced. Therefore, this measure is not effective at reducing the risk of injury to animals once the firing activity has begun; however, it does reduce the risk for those individuals that may be observed prior to commencement of the activity when aircraft are firing. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [*Sargassum* or kelp paddies]) will further help avoid impacts on marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. The 30-min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. The 30-min. wait period represents the maximum wait period acceptable for certain types of aircraft involved in this activity (e.g., maritime patrol aircraft) based on their specific fuel restrictions. Requiring additional delay beyond 30 min. for these platforms would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would result in an unacceptable increased risk to personnel safety or would require aircraft to depart the activity location to refuel, which would reduce the aircrews' abilities to approach surface targets and launch missiles as would be required in a real world combat situation; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The 10-min. wait period covers a portion of the average marine mammal and sea turtle dive times but may not be sufficient to cover the average dive times of all species. The 10-min. wait period is based on the specific fuel restrictions for the other types of aircraft involved in this activity (e.g., helicopters). Requiring additional delay beyond 10 min. for these platforms would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would result in an unacceptable increased risk to personnel safety or would require aircraft to depart the activity location to refuel, which would reduce the aircrews' abilities to approach surface targets and launch missiles as would be required in a real world combat situation; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.9 Missile Exercises Using 251–500 Pound Net Explosive Weight Using a Surface Target

Recommended Mitigation and Comparison to Current Mitigation

Mitigation measures do not currently exist for this activity. Refer to Section 5.3.3.2.1.1 (Shallow Coral Reefs, Hard Bottom Habitat, Artificial Reefs, and Shipwrecks) for information on mitigation designed to avoid or reduce potential impacts from military expended materials within shallow coral reef mitigation areas. The recommended measures are provided below.

When aircraft are firing, mitigation will include visual observation by the aircrew or supporting aircraft prior to commencement of the activity within a mitigation zone of 2,000 yd. (1.8 km) around the intended impact location. The exercise will not commence if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is 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 and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 min. or 30 min. (depending on aircraft type).

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential impacts they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for a missile exercise using 251–500 lb. net explosive weight (bin E10) is 1,883 yd. (1.7 km). This range was determined by the sea turtle functional hearing group. The marine mammal functional hearing groups had a shorter range to onset of PTS, so the mitigation zone will provide further protection for these species. The average range to onset of TTS across all functional hearing groups is 1,832 yd. (1.7 km). Implementation of the 2,000-yd. (1.8-km) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted.

Missile exercises involve the participating ship or aircraft firing munitions at a target location typically up to 15 nm away and infrequently include ranges up to 75 nm away. When an aircraft is firing, the aircraft can travel close to the intended impact area so that it can be visually observed. Because that type of observation is not possible for a ship, visual observation is not suitable for activities that involve a ship-fired missile. Even with aircraft firing, there is a chance that animals could enter the impact area after the visual observations have been completed and the activity has commenced. Therefore, this measure is not effective at reducing the risk of injury to animals once the firing activity has begun; however, it does reduce the risk for those individuals that may be observed prior to commencement of the activity when aircraft are firing. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [*Sargassum* or kelp paddies]) will further help avoid impacts on marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. The 30-min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. The 30-min. wait period represents the maximum wait period acceptable for certain types of aircraft involved in this activity (e.g., maritime patrol aircraft) based on their specific fuel restrictions. Requiring additional delay beyond 30 min. for these platforms would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would result in an unacceptable increased risk to personnel safety or would require aircraft to depart the activity location to refuel, which would reduce the aircrews' abilities to approach surface targets and launch missiles as would be required in a real world combat situation; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The 10-min. wait period covers a portion of the average marine mammal and sea turtle dive times but may not be sufficient to cover the average dive times of all species. The 10-min. wait period is based on the specific fuel restrictions for the other types of aircraft involved in this activity (e.g., helicopters). Requiring additional delay beyond 10 min. for these platforms would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would result in an unacceptable increased risk to personnel safety or would require aircraft to depart the activity location to refuel, which would reduce the aircrews' abilities to approach surface targets and launch missiles as would be required in a real world combat situation; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.10 Bombing Exercises

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to (1) modify the mitigation measures currently implemented for this activity by reducing the mitigation zone from 5,100 yd. (4.7 km) to 2,500 yd. (2.3 km), (2) clarify the conditions needed to recommence an activity after a sighting, (3) add a requirement to visually observe for kelp paddies, and (4) adopt the marine mammal and sea turtle mitigation zone size for floating vegetation for ease of implementation. Refer to Section 5.3.3.2.1.1 (Shallow Coral Reefs, Hard Bottom Habitat, Artificial Reefs, and Shipwrecks) for information on mitigation designed to avoid or reduce potential impacts from military expended materials within shallow coral reef mitigation areas. The recommended measures are provided below.

Mitigation will include visual observation from the aircraft immediately before the exercise and during target approach within a mitigation zone of 2,500 yd. (2.3 km) around the intended impact location. The exercise will not commence if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone. Bombing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Bombing will recommence if any one of the following conditions is 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 and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 min.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential impacts they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for bombing exercises is 2,474 yd. (2.3 km). This range was determined by the sea turtle functional hearing group. The marine mammal functional hearing groups had a shorter range to onset of PTS, so the mitigation zone will provide further protection for these species. For example, the maximum range to onset of PTS to mid-frequency of cetaceans is less than 500 yd. (457 m). The average range to onset of TTS across all functional hearing groups is 2,513 yd. (2.3 km). Implementation of the 2,500-yd. (2.3-km) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted.

The predicted maximum range to onset mortality across all functional hearing groups is less than 250 yd. (229 m). Therefore, this measure will be effective at reducing potential mortality to all marine mammals and sea turtles when individuals are sighted. As discussed in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), it is highly unlikely that anything but a whale blow or large pod of dolphins will be seen at distances closer to 2,500 yd. (2.3 km) near the perimeter of the mitigation zone. However, this measure is likely effective at reducing the risk of injury to marine mammals and sea turtles that may be observed from the smaller distances within the mitigation zone. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [*Sargassum* or kelp paddies]) will further help avoid impacts on marine mammals and sea turtles.

As described in Section 5.3.1 (Lookout Procedural Measures), Lookouts positioned in aircraft may be responsible for tasks in addition to observing the air or surface of the water. For example, a Lookout for this activity may also be responsible for navigation of the aircraft. Having a Lookout observe a mitigation zone that is too large could potentially increase the safety risk due to an increased level of distraction from normal job duties. Similarly, Lookouts posted in aircraft during bombing activities will, by necessity, focus their attention on the water surface below and surrounding the location of bomb deployment. Due to the nature of this activity (e.g., aircraft maintaining a relatively steady altitude of approximately 1,500 ft. and approaching the intended impact location), Lookouts will be able to observe a larger area during bombing activities than other proposed activities that involve the use of Lookouts positioned in aircraft (e.g., Improved Extended Echo Ranging sonobuoy activities). However, observation of an area beyond what the Navy is proposing to implement for bombing activities is not practical and would not likely result in avoidance or reduction of injury to marine mammals or sea turtles because the effort spent observing those more distant areas would inevitably be minimal. The decrease in mitigation zone size will result in no mitigation for exposure to lower levels of potential onset of TTS; however, it will allow for a more focused survey effort over a smaller survey distance, and will consequently increase the likelihood of avoidance of injury and larger threshold shifts that would result in recovery (i.e., TTS) to marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. The 10-min. wait period covers a portion of the average marine mammal and sea turtle dive times but may not be sufficient to cover the average dive times of all species. The 10-min. wait period is based on fuel restrictions (factoring in the typical activity locations) for the types of aircraft involved in this activity (e.g., F/A-18). Requiring additional delay beyond 10 min. for these platforms would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would result in an unacceptable increased risk to personnel safety or would require aircraft to depart the activity location to refuel, which would reduce the aircrews' abilities to approach surface targets and deliver bombs as would be required in a real world combat situation; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.11 Torpedo (Explosive) Testing

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to (1) modify the mitigation measures currently implemented for this activity by reducing the mitigation zone from 5,063 yd. (4.6 km) to 2,100 yd. (1.9 km), (2) clarify the conditions needed to recommence an activity after a sighting, (3) add a requirement to visually observe for kelp paddies, and (4) remove the requirement to review remotely sensed sea surface temperature maps prior to conducting the activity. The recommended measures are provided below.

Mitigation will include visual observation by aircraft (with the exception of platforms operating at high altitudes) immediately before, during, and after the exercise within a mitigation zone of 2,100 yd. (1.9 km) around the intended impact location. The exercise will not commence if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal, sea turtle, or aggregation of jellyfish is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is 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 and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 min. or 30 min. (depending on aircraft type).

In addition to visual observation, passive acoustic monitoring would be conducted with Navy assets, such as passive ships sonar systems or sonobuoys, already participating in the activity. Passive acoustic observation would be accomplished through the use of remote acoustic sensors, expendable sonobuoys, or via passive acoustic sensors on submarines when they participate in the Proposed Action. These assets would only detect vocalizing marine mammals within the frequency bands monitored by Navy personnel. Passive acoustic detections would not provide range or bearing to detected animals, and therefore cannot provide locations of these animals. Passive acoustic detections would be reported to the Lookout posted in the aircraft in order to increase vigilance of the visual observation; and to the person in control of the activity for their consideration in determining when the mitigation zone is determined free of visible marine mammals.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential impacts they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for explosive torpedoes is 2,021 yd. (1.8 km). This range was determined by the sea turtle functional hearing group. The marine mammal functional hearing groups had a shorter range to onset of PTS, so the mitigation zone will provide further protection for these species. The average range to onset of TTS across all functional hearing groups is 1,632 yd. (1.5 km). Implementation of the 2,100-yd. (1.9-km) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted.

The predicted maximum range to onset mortality across all functional hearing groups is less than 600 yd. (549 m). Therefore, this measure will be effective at reducing potential mortality to all marine mammals and sea turtles when individuals are sighted. As discussed in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), it is highly unlikely that anything but a whale blow or large pod of dolphins will be seen at distances closer to 2,100 yd. (1.9 km) near the perimeter of the mitigation zone. However, this measure is likely effective at reducing the risk of injury to marine mammals and sea turtles that may be observed from the smaller distances within the mitigation zone.

As described in Section 5.3.1 (Lookout Procedural Measures), Lookouts positioned in aircraft may be responsible for tasks in addition to observing the air or surface of the water. For example, a Lookout for this activity may also be responsible for navigation of the aircraft. Having a Lookout observe a mitigation zone that is too large could potentially increase the safety risk due to an increased level of distraction from normal job duties. Observation of an area beyond what the Navy is proposing to implement for torpedo (explosive) testing activities is not practical and would not likely result in avoidance or reduction of injury to marine mammals or sea turtles because the effort spent observing those more distant areas would inevitably be minimal. The decrease in mitigation zone size will result in no mitigation for exposure to lower levels of potential onset of TTS; however, it will allow for a more focused survey effort over a smaller survey distance, and will consequently increase the likelihood of avoidance of injury and larger threshold shifts that would result in recovery (i.e., TTS) to marine mammals and sea turtles. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [*Sargassum* or kelp paddies] and jellyfish aggregations) will further help avoid impacts on marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. The 30-min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. The 30-min. wait period represents the maximum wait period acceptable for certain types of aircraft involved in this activity (e.g., maritime patrol aircraft) based on their specific fuel restrictions. Requiring additional delay beyond 30 min. for these platforms would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would result in an unacceptable increased risk to personnel safety or would require aircraft to depart the activity location to refuel, which would reduce the aircrews' abilities to approach surface targets and launch torpedoes as would be required in a real world combat situation; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The 10-min. wait period covers a portion of the average marine mammal and sea turtle dive times but may not be sufficient to cover the average dive times of all species. The 10-min. wait period is based on the specific fuel restrictions for the other types of aircraft involved in this activity (e.g., helicopters). Requiring additional delay beyond 10 min. for these platforms would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would result in an unacceptable increased risk to personnel safety or would require aircraft to depart the activity location to refuel, which would reduce the aircrews' abilities to approach surface targets and launch torpedoes as would be required in a real world combat situation; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The original intent of the measure requiring the review of remotely sensed sea surface temperature maps was to help predict areas in which protected species could occur. However, while the presence of sea surface temperature fronts may indicate suitable habitat for marine species and may sometimes lead observers to pay more attention to an area of the ocean likely to be associated with a marine species, sea surface temperature fronts alone are insufficient to locate and prevent avoidance of marine species during this type of exercise.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.12 Sinking Exercises

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to (1) modify the mitigation measures currently implemented for this activity by reducing the mitigation zone from 4.5 nm to 2.5 nm, (2) clarify the conditions needed to recommence an activity after a sighting, (3) add a requirement to visually observe for kelp paddies, and (4) adopt the marine mammal and sea turtle mitigation zone size for floating vegetation and jellyfish for ease of implementation. The recommended measures are provided below.

Mitigation will include visual observation within a mitigation zone of 2.5 nm around the target ship hulk. Sinking exercises will include aerial observation beginning 90 min. before the first firing, visual observations from vessels throughout the duration of the exercise, and both aerial and vessel observation immediately after any planned or unplanned breaks in weapons firing of longer than 2 hours. Prior to conducting the exercise, the Navy will review remotely sensed sea surface temperature and sea surface height maps to aid in deciding where to release the target ship hulk.

The Navy will also monitor using passive acoustics during the exercise. Passive acoustic monitoring would be conducted with Navy assets, such as passive ships sonar systems or sonobuoys, already participating in the activity. These assets would only detect vocalizing marine mammals within the frequency bands monitored by Navy personnel. Passive acoustic detections would not provide range or bearing to detected animals, and therefore cannot provide locations of these animals. Passive acoustic detections would be reported to Lookouts posted in aircraft and on vessels in order to increase vigilance of their visual observation. Lookouts will also increase observation vigilance before the use of torpedoes or unguided ordnance with a net explosive weight of 500 lb. or greater, or if the Beaufort sea state is a 4 or above.

The exercise will not commence if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone. The exercise will cease if a marine mammal, sea turtle, or aggregation of jellyfish is sighted within the mitigation zone. The exercise will recommence if any one of the following conditions is 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 and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 min. Upon sinking the vessel, the Navy will conduct post-exercise visual observation of the mitigation zone for 2 hours (or until sunset, whichever comes first).

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential impacts they are designed to reduce. During a sinking exercise, multiple weapons sources may be used (e.g., projectiles, missiles, bombs, and torpedoes), the largest of which is the 2,000 lb. bomb. The recommended mitigation zone is approximately double the predicted maximum range to onset of PTS of the largest weapon source and is designed to account for multiple detonations during the activity. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for a bombing exercise is 2,474 yd. (2.3 km). This range was determined by the sea turtle functional hearing group. The marine mammal functional hearing groups had a shorter range to onset of PTS, so the mitigation zone will provide further protection for these species. For example, the maximum range to onset of PTS to mid-frequency of cetaceans is less than 500 yd.

(457 m). The average range to onset of TTS across all functional hearing groups is 2,513 yd. (2.3 km). Implementation of the 2.5-nm mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted.

The predicted maximum range to onset mortality across all functional hearing groups is less than 250 yd. (229 m). Therefore, this measure will be effective at reducing potential mortality to all marine mammals and sea turtles when individuals are sighted. As discussed in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), it is highly unlikely that anything but a whale blow or large pod of dolphins will be seen at distances closer to 2.5 nm near the perimeter of the mitigation zone. However, this measure is likely effective at reducing the risk of injury to marine mammals and sea turtles that may be observed from the smaller distances within the mitigation zone.

As described in Section 5.3.1 (Lookout Procedural Measures), Lookouts positioned in aircraft or vessels may be responsible for tasks in addition to observing the air or surface of the water. For example, a Lookout for this activity may also be responsible for navigation of the aircraft. Having a Lookout observe a mitigation zone that is too large could potentially increase the safety risk due to an increased level of distraction from normal job duties. Observation of an area beyond what the Navy is proposing to implement for sinking exercises is not practical and would not likely result in avoidance or reduction of injury to marine mammals or sea turtles because the effort spent observing those more distant areas would inevitably be minimal. The decrease in mitigation zone size will result in no mitigation for exposure to lower levels of potential onset of TTS; however, it will allow for a more focused survey effort over a smaller survey distance, and will consequently increase the likelihood of avoidance of injury and larger threshold shifts that would result in recovery (i.e., TTS) to marine mammals and sea turtles. The amount of time it takes for an aircraft to conduct line transects around a detonation point within the currently implemented 4.5-nm mitigation zone could result in animals entering the mitigation zone at one end while the aircraft completes the survey at the other end of the mitigation zone. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [*Sargassum* or kelp paddies] and jellyfish aggregations) will further help avoid impacts on marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30-min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.4.3.1.9 (Impacts from Explosives) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur. Requiring additional delay beyond 30 min. would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would reduce the ship and aircrews' abilities to coordinate attack tactics on a seaborne target as would be required in a real world combat situation; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise. Although activities involving certain types of aircraft (e.g., helicopters) typically employ a 10-min. wait period due to fuel restrictions, the Navy is able to make an exception for this particular activity due to the large variation and rotation of assets that could participate in this type of exercise.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.13 At-Sea Explosive Testing

Recommended Mitigation and Comparison to Current Mitigation

Mitigation measures do not currently exist for at-sea explosive testing activities. Refer to Section 5.3.3.2.1.1 (Shallow Coral Reefs, Hard Bottom Habitat, Artificial Reefs, and Shipwrecks) for information on mitigation designed to avoid or reduce potential impacts from military expended materials within shallow coral reef mitigation areas. The Navy is proposing to add the recommended measures provided below.

Mitigation during at-sea explosive testing, such as the sinking of a vessel by a sequential firing of multiple small charges (e.g., explosives in bin E5) for use as an artificial reef, will include visual observation from supporting vessels immediately before and during the activity within a mitigation zone of 1,600 yd. (1.4 km) around the intended impact location. The exercise will not commence if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone. Detonations will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Detonations will recommence if any one of the following conditions is 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 and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 min.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential impacts they are designed to reduce. During at-sea explosive testing, multiple weapons sources or charges may be used (projectiles and charges), the largest of which is a 10 lb. net explosive weight charge. The recommended mitigation zone is approximately double the predicted maximum range to onset of PTS of the largest source, and is designed to account for multiple detonations during the activity. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for at-sea explosive testing is 649 yd. (593 m). This range was determined by the high-frequency cetacean functional hearing group. The remaining functional hearing groups had a shorter range to onset of PTS, so the mitigation zone will provide further protection for these species. The average range to onset of TTS across all functional hearing groups is 525 yd. (480 m). Implementation of the 1,600-yd. (1.4-km) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted.

The predicted maximum range to onset mortality across all functional hearing groups is less than 60 yd. (55 m). Therefore, this measure will be effective at reducing potential mortality to all marine mammals and sea turtles when individuals are sighted. This measure is likely also effective at reducing the risk of injury to marine mammals and sea turtles within the maximum range to onset of PTS (649 yd. [593 m]). As discussed in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), the likelihood of sighting individual animals, particularly sea turtles and some species of small or cryptic marine mammals, from a vessel decreases at long distances; therefore, this measure is likely ineffective at reducing impacts on sea turtles and some species of marine mammals at distances closer to 1,600 yd. (1.4 km) near the perimeter of the mitigation zone. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [*Sargassum* or kelp paddies]) will further help avoid impacts on marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30-min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.4.3.1.9 (Impacts from Explosives) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur. Requiring additional delay beyond 30 min. would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would reduce the vessel's ability to determine the pressure generated, which is used to test the feasibility of using various net explosive weight sizes for different events; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of injury to some species of marine mammals, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.14 Ordnance Testing – Line Charge Testing

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to (1) increase the mitigation zone from 880 yd. (805 m) to 900 yd. (823 m), (2) add the requirement to cease the activity after a marine mammal or sea turtle is sighted in the mitigation zone, (3) clarify the conditions needed to recommence an activity after a sighting, (4) add a requirement to visually observe for floating vegetation, and (5) discontinue visual observations for the Gulf sturgeon. Currently, if a Gulf sturgeon is sighted close to the line charge detonation point, tests are postponed until the animal is over 0.5 mile (mi.) (0.8 km) from the detonation point. The recommended measures are provided below.

Mitigation will include visual observation from a vessel immediately before and during the exercise within a mitigation zone of 900 yd. (823 m) around the line charges. The exercise will not commence if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone. Detonations will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Detonations will recommence if any one of the following conditions is 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 and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 min.

Effectiveness and Operational Assessments

Visual observation for Gulf sturgeon (including determining if a sturgeon has moved more than 0.5 mi. [0.8 km] away from the detonation point) does not effectively reduce the potential for impacts on the species to occur due to the extreme difficulty of sighting a primarily bottom dwelling fish below the water's surface. Activity in the surf zone (e.g., deployment of the line charges) prior to commencement of the detonation will likely result in Gulf sturgeon leaving the immediate area of their own volition. Refer to Section 5.3.3.5.1.1 (Gulf Sturgeon Habitat in the Gulf of Mexico) for a discussion of mitigation measures conducted within Gulf sturgeon habitat.

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential impacts they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for line charge testing is 563 yd.

(515 m). This range was determined by the high-frequency cetacean functional hearing group. The remaining functional hearing groups had a shorter range to onset of PTS, so the mitigation zone will provide further protection for these species. The average range to onset of TTS across all functional hearing groups is 434 yd. (397 m). Implementation of the 900-yd. (823-m) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted.

This activity involves launching the line charge array at the beach. Therefore it is necessary for the Lookout to be able to visually observe the mitigation zone from this distance. Very few marine mammal species would be present in the surf zone, except coastal dolphins and manatees. Although the Lookout will observe for all marine mammals or sea turtles in the area, as discussed in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), it is highly unlikely that anything but a large pod of dolphins will be seen from long distances from this vantage point. Although this measure is likely ineffective at reducing the risk of injury to sea turtles and manatees, it does reduce the risk for those individuals that may be observed. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [*Sargassum* or kelp paddies]) will further help avoid impacts on marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30-min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.4.3.1.9 (Impacts from Explosives) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur. Requiring additional delay beyond 30 min. would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would reduce the vessel's ability to verify the capability to safely clear surf zone areas for sea-based expeditionary operations; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to some marine mammal species, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.15 Ship Shock Trials

Recommended Mitigation and Comparison to Current Mitigation

The Navy develops detailed ship shock trial mitigation plans approximately 1 year prior to each ship shock trial event and will continue to provide these plans to NMFS. The recommended mitigation zone measures specific to ship shock trials using 10,000-lb. and 40,000-lb. charges are provided below.

10,000-Pound Charges (High Blast Explosive)

The Navy is proposing to (1) continue implementing mitigation measures based on the largest mitigation zone of the most recently conducted ship shock trial (Mesa Verde, which used 10,000-lb. charges), (2) clarify the conditions needed to recommence an activity after a sighting, (3) add a requirement to visually observe for kelp paddies, (4) add an option to conduct visual observations using only vessels. The recommended measures are provided below.

Mitigation will include aerial or shipboard observation prior to, during, and after completion of the event within a mitigation zone of 3.5 nm around the shock trial location. Pre-planning will include selection of one primary and two secondary areas where marine mammal populations are expected to be the lowest during the event. The primary and secondary locations will be greater than 2 nm from the western boundary of the Gulf Stream.

The Navy will conduct aerial or shipboard visual observations of the mitigation zone at intervals of 5 hours, 3 hours, and 40 min. prior to detonation and immediately before each detonation at the primary shock trial location. The exercise will not commence if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone. If it is determined during pre-detonation surveys that the primary area is environmentally unsuitable (e.g., observations of marine mammals or presence of concentrations of floating vegetation [*Sargassum* or kelp paddies]), the shock trial could be moved to a secondary site. Details of this process will be provided in the ship-specific mitigation plan. The detonation will cease if marine mammals, sea turtles, large schools of fish, jellyfish aggregations, or flocks of seabirds are visually observed within the mitigation zone. The detonation will recommence if any one of the following conditions is met: (1) the species is observed exiting the mitigation zone, (2) the species is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 min. The Navy will visually observe the mitigation zone immediately after each detonation for 3 hours. Mitigation will also include observation for a minimum of 2 days and no more than 7 days following a detonation. If any injured or dead marine mammals or sea turtles are detected in the mitigation zone during the post-detonation observation, the remainder of the activity will be halted until procedures for subsequent detonations can be reviewed and changed as necessary.

40,000-Pound Charges (High Blast Explosive)

Lookout measures do not currently exist for this activity because it is a new activity. The Navy is proposing to add mitigation for this activity. The recommended measures are provided below.

Mitigation will include aerial and shipboard observation prior to, during, and after completion of the event within a mitigation zone of 3.5 nm around the shock trial location. Pre-planning will include selection of one primary and two secondary areas where marine mammal populations are expected to be the lowest during the event. The primary and secondary locations will be located greater than 2 nm from the western boundary of the Gulf Stream.

The Navy will conduct shipboard and aerial visual observations of the mitigation zone at intervals of 5 hours, 3 hours, and 40 min. prior to detonation and immediately before each detonation at the primary shock trial location. The exercise will not commence if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone. If it is determined during pre-detonation surveys that the primary area is environmentally unsuitable (e.g., observations of marine mammals or presence of concentrations of floating vegetation [*Sargassum* or kelp paddies]), the shock trial could be moved to a secondary site. Details of this process will be provided in the ship-specific mitigation plan. The detonation will cease if marine mammals, sea turtles, large schools of fish, jellyfish aggregations, or flocks of seabirds are visually observed within the mitigation zone. The detonation will recommence if any one of the following conditions is met: (1) the species is observed exiting the mitigation zone, (2) the species is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 min. The Navy will visually observe the mitigation zone immediately after each detonation for 3 hours. Mitigation will also include observation for a minimum of 2 days and no more than 7 days following a detonation. If any injured or dead marine mammals or sea turtles are detected in the mitigation zone during the post-detonation observation, the remainder of the activity will be halted until procedures for subsequent detonations can be reviewed and changed as necessary.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential impacts they are designed to reduce. Table 5.3-2 shows the predicted maximum range to PTS based on the Navy's acoustic propagation model for all charge sizes and locations. As shown, the predicted maximum ranges to onset of PTS are larger than the recommended mitigation zone. However, for the 10,000-lb. charges, the longest average range to PTS across all functional hearing groups between the two locations is 2.7 nm. For the 40,000-lb. charges, the longest average range to PTS across all functional hearing groups between the two locations is 3.7 nm. Implementation of the 3.5-nm mitigation zone is still likely to reduce the majority of the potential for exposure to higher levels of energy that would result in injury, when individuals are sighted.

The predicted maximum range to onset mortality across all functional hearing groups is 3,000 yd. (2.8 km) for the 10,000-lb. charge and 4,800 yd. (4.4 km) for the 40,000-lb. charge. This measure will be effective at reducing potential mortality to all marine mammals and sea turtles when individuals are sighted due to the number of combination of observation platforms in use. As discussed in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), it is highly unlikely that anything but a whale blow or large pod of dolphins will be seen at distances closer to 3.5 nm near the perimeter of the mitigation zone. However, this measure is likely effective at reducing the risk of injury to marine mammals and sea turtles that may be observed from the smaller distances within the mitigation zone. The ability to detect indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [*Sargassum* or kelp paddies], jellyfish aggregations, large schools of fish, and flocks of seabirds) decreases at long distances when observing from a vessel; however, observation will further help avoid impacts on marine mammals and sea turtles.

For ship shock trials using up to 10,000-lb. charges, aerial surveys are not always operationally feasible due to resource limitations. As discussed in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), the likelihood of sighting individual animals from a vessel, particularly sea turtles and some species of small or cryptic marine mammals, decreases at long distances. However, if vessels are used as the sole observation platform, the Navy's use of a sufficient number of vessels (e.g., Marine Animal Response Team boats) will ensure that the mitigation zone is visually observed with effectiveness comparable to aerial surveys.

For ship shock trials using up to 40,000-lb. charges, the Navy estimates that 3.5 nm is the upper limit of effectiveness for aerial observation during ship shock trials based on the amount of time it takes for the aircraft to patrol the area. Larger survey areas would result in an unacceptable increase to the amount of time it would take for an aircraft to conduct line transects around the detonation point. The longer an aircraft spends transiting the survey area, the less focused the survey becomes at observing individuals that may be present close to the detonation. For instance, animals could potentially enter one end of the mitigation zone unnoticed while the aircraft conducts its survey at the opposite end of mitigation zone. The Navy believes that a more focused survey effort over a smaller survey distance will provide the most effective means for helping reduce potential impacts on marine mammals and sea turtles during ship shock trials, even if the mitigation zone is smaller than the full extent of the predicted range to PTS for some charge sizes or locations.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30-min. wait period covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. Requiring additional delay beyond 30 min. would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would reduce the Navy's opportunity to simulate shock waves at various distances from the ship's hull that would be expected during a real world combat situation; and would therefore have an unacceptable impact on the realism and effectiveness of the test.

The Navy proposes implementing the recommended measures described above because (1) they are likely to result in avoidance or reduction of injury to some marine species, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.16 Elevated Causeway System – Pile Driving

Recommended Mitigation and Comparison to Current Mitigation

Mitigation measures do not currently exist for this activity. The Navy is proposing to add the recommended measures provided below.

Mitigation will include visual observation from a small boat, the elevated causeway, or from shore starting 30 min. prior to and during the exercise within a mitigation zone of 60 yd. (55 m) around the pile driver. The exercise will not commence if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone. Pile driving will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Pile driving will recommence if any one of the following conditions is 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 and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 min.

Effectiveness and Operational Assessments

See the introduction of Section 5.3.2 (Mitigation Zone Procedural Measures) for a general discussion of mitigation zones, how they are implemented, and the potential impacts they are designed to reduce. As shown in Table 5.3-2, the predicted maximum range to onset of PTS for pile driving exercises is 51 yd. (46 m). This range was determined by the injury threshold of 180 dB root mean square for cetaceans. The average range to onset of TTS is 1,094 yd. (1 km). Implementation of the 60-yd. (55-m) mitigation zone will reduce the potential for exposure to higher levels of energy that would result in injury and larger threshold shifts that would result in recovery (i.e., TTS) when individuals are sighted. Since the mitigation zone is so small, this measure should be effective at reducing the risk to all marine mammals and sea turtles that are available to be observed within the mitigation zone. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [*Sargassum* or kelp paddies]) will further help avoid impacts on marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30-min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.4.3.1.10 (Impacts from Pile Driving) shows that injury to deep-diving marine mammals (e.g., sperm whales and beaked whales) is not expected to occur. Requiring additional delay beyond 30 min. would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would reduce the crew's ability to construct the causeway platform in a manner that would be expected during a real world combat situation; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of injury to marine mammals and sea turtles, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.1.2.17 Weapons Firing Noise During Gunnery Exercises – Large-Caliber

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to (1) modify the currently implemented mitigation measure to clarify that the mitigation zone is only on the firing side of the ship, (2) clarify the conditions needed to recommence an activity after a sighting, and (3) add a requirement to visually observe for floating vegetation. The recommended measures are provided below.

For all explosive and non-explosive large-caliber gunnery exercises conducted from a ship, mitigation will include visual observation immediately before and during the exercise within a mitigation zone of 70 yd. (64 m) within 30 degrees on either side of the gun target line on the firing side. The exercise will not commence if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is 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 and speed and the relative motion between the animal and the source, (3) the mitigation zone has been clear from any additional sightings for a period of 30 min., or (4) the ship has repositioned itself more than 140 yd. (128 m) away from the location of the last sighting.

Effectiveness Assessment

The mitigation zone is designed to reduce the potential for injury from weapons firing noise during large-caliber gunnery exercises conducted from a ship. The majority of the energy that an animal could be exposed to would occur on the firing side of the ship and would follow in the direction of fire. It is not operationally feasible to have Lookouts stationed on all sides of the ship to visually observe for marine mammals and sea turtles due to limited resources (e.g., manning restrictions). Since the Lookout is positioned aboard the firing ship and is visually observing a small area (70 yd. [64 m]), this measure should be effective at reducing the risk to all marine mammals and sea turtles that available to be observed. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [*Sargassum* or kelp paddies]) will further help avoid impacts on marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30-min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for sea turtles. However, the analysis in Section 3.4.3.1.12 (Impacts from Weapons Firing, Launch, and Impact Noise) shows that injury to marine mammals is not expected to occur. Requiring additional delay beyond 30 min. would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would reduce the gun crews' abilities to engage surface targets and practice defensive marksmanship as would be required in a real world combat situation; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to marine mammals and sea turtles and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.2 Physical Disturbance and Strikes

5.3.2.2.1 Vessels and In-Water Devices

5.3.2.2.1.1 Vessels

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to continue using the mitigation measures currently implemented. The recommended measures are provided below.

Vessels will avoid approaching marine mammals head on and will maneuver to maintain a mitigation zone of 500 yd. (457 m) around observed whales and 200 yd. (183 m) around all other marine mammals (except bow riding dolphins), providing it is safe to do so. For additional information on species-specific mitigations pertaining to vessel strikes within mitigation areas, see Section 5.3.3.1.1 (North Atlantic Right Whale) and Section 5.3.3.1.2 (West Indian Manatee).

Effectiveness and Operational Assessments

Since the Lookout is visually observing within a reasonable distance of the vessel (within 500 yd. [457 m]), this measure should be effective at reducing the risk to marine mammals that are available to be observed. However, as discussed above in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), large whales and pods of dolphins are more likely to be seen than other more cryptic species, such as beaked whales.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of injury to marine mammals, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.2.1.2 Towed In-Water Devices

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to continue using the mitigation measures currently implemented. The recommended measure is provided below.

The Navy will ensure that towed in-water devices being towed from manned platforms avoid coming within a mitigation zone of 250 yd. (229 m) around any observed marine mammal, providing it is safe to do so.

Effectiveness and Operational Assessments

Since the Lookout is visually observing within a reasonable distance of the vessel (250 yd. [229 m]), this measure should be effective at reducing the risk to marine mammals that are observable. However, as discussed above in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), large whales and pods of dolphins are more likely to be seen than other more cryptic species such as beaked whales.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of injury to marine mammals, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.2.2 Non-Explosive Practice Munitions

5.3.2.2.2.1 Non-Explosive Gunnery Exercises – Small-, Medium-, and Large-Caliber Using a Surface Target

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to (1) continue using the mitigation measures currently implemented for this activity, and (2) clarify the conditions needed to recommence an activity after a sighting. The recommended measures are provided below.

Mitigation will include visual observation immediately before and during the exercise within a mitigation zone of 200 yd. (183 m) around the intended impact location. The exercise will not commence if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is 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 and speed and the relative motion between the animal and the source, (3) the mitigation zone has been clear from any additional sightings for a period of 10 min. for a firing aircraft, (4) the mitigation zone has been clear from any additional sightings for a period of 30 min. for a firing vessel, or (5) the intended target location has been repositioned more than 400 yd. (366 m) away from the location of the last sighting.

Effectiveness and Operational Assessments

The mitigation zone is designed to reduce the potential for direct strike from a non-explosive projectile. Large-caliber gunnery exercises involve the participating ship firing munitions at a target location from ranges up to 6 nm away. Small- and medium-caliber gunnery exercises involve the participating vessel or aircraft firing munitions at a target location from up to 2 nm away, although typically closer. Therefore it is necessary for the Lookout to be able to visually observe the mitigation zone from these distances. Although the Lookout will observe for all marine mammals or sea turtles in the area, as discussed in Section 5.3.1.2.4 (Effectiveness Assessment for Lookouts), it is highly unlikely that anything but a whale blow or large pod of dolphins will be seen at distances closer to 6 nm (i.e., at the furthest target distance for large-caliber gunnery exercises) or 2 nm (i.e., at the furthest target distance for small- and medium-caliber gunnery exercises). Although this measure is likely ineffective at reducing the risk of injury to sea turtles and some species of marine mammals, it does reduce the risk for those individuals that may be observed. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [*Sargassum* or kelp paddies]) will further help avoid impacts on marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. A 30-min. wait period when vessels are firing more than covers the average dive times of most marine mammal species but may not be sufficient for sea turtles. However, the analysis in Section 3.4.3.3.3 (Impacts from Military Expended Materials) shows that injury to marine mammals and sea turtles is not expected to occur. Requiring additional delay beyond 30 min. for a firing vessel would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would reduce the gun crews' abilities to engage surface targets and practice defensive marksmanship as would be required in a real world combat situation; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The 10-min. wait period for a firing aircraft covers a portion of the average marine mammal and sea turtle dive times but may not be sufficient to cover the average dive times of all species. The 10-min. wait period is based on fuel restrictions for the types of aircraft involved in this activity (e.g., helicopters). Requiring additional delay beyond 10 min. for these sources would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would result in an unacceptable increased risk to personnel safety or would require aircraft to depart the activity location to refuel, which would eliminate opportunities and reduce the gun crews' abilities to engage surface targets and practice defensive marksmanship as would be required in a real world combat situation; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of injury to some species of marine mammals, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.2.2.2 Bombing Exercises

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to (1) continue using the mitigation measures currently implemented for this activity, and (2) clarify the conditions needed to recommence an activity after a sighting. The recommended measures are provided below.

Mitigation will include visual observation from the aircraft immediately before the exercise and during target approach within a mitigation zone of 1,000 yd. (914 m) around the intended impact location. The exercise will not commence if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone. Bombing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Bombing will recommence if any one of the following conditions is 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 and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 min.

Effectiveness and Operational Assessments

The mitigation zone is designed to reduce the potential for direct strike from a non-explosive bomb. The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. The 10-min. wait period covers a portion of the average marine mammal and sea turtle dive times but may not be sufficient to cover the average dive times of all species. The 10-min. wait period is based on fuel restrictions for the types of aircraft involved in this activity (e.g., F/A-18). Requiring additional delay beyond 10 min. for these platforms would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would result in an unacceptable increased risk to personnel safety or would require aircraft to depart the activity location to refuel, which would reduce the aircrews' abilities to approach surface targets and deliver bombs as would be required in a real world combat situation; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [*Sargassum* or kelp paddies]) will further help avoid impacts on marine mammals and sea turtles.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of injury to marine mammals and sea turtles, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.2.2.2.3 Missile Exercises (Including Rockets) Using a Surface Target

The Navy is proposing to (1) modify the mitigation measures currently implemented for this activity by reducing the mitigation zone from 1,800 yd. (1.6 km) to 900 yd. (823 m), (2) clarify the conditions needed to recommence an activity after a sighting, (3) adopt the marine mammal and sea turtle mitigation zone size for floating vegetation for ease of implementation, and (4) modify the platform of observation to eliminate the requirement to observe when ships are firing. Refer to Section 5.3.3.2.1.1 (Shallow Coral Reefs, Hard Bottom Habitat, Artificial Reefs, and Shipwrecks) for information on mitigation designed to avoid or reduce potential impacts from military expended materials within shallow coral reef mitigation areas. The recommended measures are provided below.

When aircraft are firing, mitigation will include visual observation by the aircrew or supporting aircraft prior to commencement of the activity within a mitigation zone of 900 yd. (823 m) around the deployed target. The exercise will not commence if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone. Firing will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Firing will recommence if any one of the following conditions is 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 and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 10 min. or 30 min. (depending on aircraft type).

<u>**Effectiveness and Operational Assessments**</u>

The mitigation zone is designed to reduce the potential for direct strike from a non-explosive projectile. Activities using non-explosive missiles (including rockets) involve the participating ship or aircraft firing munitions at a target location typically up to 15 nm away and infrequently include ranges up to 75 nm away. When an aircraft is firing, the aircraft can travel close to the intended impact area so that it can be visually observed. Because that type of observation is not possible for a ship, visual observation is not suitable for activities that involve a ship-fired missile. Even with aircraft firing, there is a chance that animals could enter the impact area after the visual observations have been completed and the activity has commenced. Observation for indicators of marine mammal and sea turtle presence (e.g., concentrations of floating vegetation [*Sargassum* or kelp paddies]) will further help avoid impacts on marine mammals and sea turtles.

The post-sighting wait period is designed to give any animals that are sighted an opportunity to leave the area before the exercise recommences but will only be employed if one of the other conditions has not already been met. The 30-min. wait period more than covers the average dive times of most marine mammal species but may not be sufficient for some deep-diving marine mammal species or for sea turtles. However, the analysis in Section 3.4.3.3.3 (Impacts from Military Expended Materials) shows that injury to marine mammals and sea turtles is not expected to occur. The 30-min. wait period represents the maximum wait period acceptable for certain types of aircraft involved in this activity (e.g., maritime patrol aircraft) based on their specific fuel restrictions. Requiring additional delay beyond

30 min. for these platforms would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would result in an unacceptable increased risk to personnel safety or would require aircraft to depart the activity location to refuel, which would reduce the aircrews' abilities to approach surface targets and launch missiles as would be required in a real world combat situation; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The 10-min. wait period covers a portion of the average marine mammal and sea turtle dive times but may not be sufficient to cover the average dive times of all species. The 10-min. wait period is based on the specific fuel restrictions for the other types of aircraft involved in this activity (e.g., helicopters). Requiring additional delay beyond 10 min. for these platforms would modify the activity in a way that it would no longer meet its intended objective. Any additional delay would result in an unacceptable increased risk to personnel safety or would require aircraft to depart the activity location to refuel, which would reduce the aircrews' abilities to approach surface targets and launch missiles as would be required in a real world combat situation; and would therefore have an unacceptable impact on the realism and effectiveness of the exercise.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of injury to marine mammals and sea turtles, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.3 MITIGATION AREAS

The Navy is proposing to implement several mitigation measures within pre-defined habitat areas in the Study Area. For the purposes of this document, the Navy will refer to these areas as "mitigation areas." As described throughout this section, these recommended mitigation areas may be based off endangered species critical habitats, endangered species reproductive areas, or bottom features. The size and location of certain habitat areas, such as the critical habitats, is subject to change over time; however, the Navy's effectiveness and operational assessments and resulting mitigation recommendations are entirely dependent on the mitigation area defined in this document. Therefore, it is important to note that the Navy is recommending implementing mitigation measures only within each area as described in this document. Applying these mitigations to additional or expanded areas could potentially result in an unacceptable impact on readiness.

5.3.3.1 Marine Mammal Habitats

5.3.3.1.1 North Atlantic Right Whale

5.3.3.1.1.1 North Atlantic Right Whale Southeast Calving Habitat

Recommended Mitigation and Comparison to Current Mitigation

To supplement the mitigation measures described in Section 5.3.2 (Mitigation Zone Procedural Measures), the Navy is proposing to (1) continue implementing seasonal measures within the North Atlantic right whale mitigation area off the southeast United States, and (2) clarify the activities that are not allowed within the mitigation area. Previous documents described these measures in terms of identifying the specific activities that are allowed in the mitigation area (i.e., precision anchorage drills, swept channel exercises, helicopter dipping sonar, search and rescue, maritime security operations, object detection activities, and use of the Shipboard Electronic System Evaluation Facility range with clearance from Mayport Harbor Operations). In order to maintain consistency throughout this chapter, these measures will now be described in terms of what activities will be minimized, restricted, or avoided. The recommended measures are provided below.

The Navy will not conduct the following activities within the mitigation area:

- Low-frequency and hull-mounted mid-frequency active sonar (except as noted below)
- High-frequency and non-hull mounted mid-frequency active sonar (excluding helicopter dipping)
- Missile activities (explosive and non-explosive)
- Bombing exercises (explosive and non-explosive)
- Underwater detonations
- Improved Extended Echo Ranging sonobuoy exercises
- Torpedo exercises (explosive)
- Small-, medium- and large-caliber gunnery exercises

The Navy will minimize to the maximum extent practicable the use of the following systems within the mitigation area:

- Helicopter dipping using active sonar
- Low-frequency and hull-mounted mid-frequency active sonar used for navigation training
- Low-frequency and hull-mounted mid-frequency active sonar used for object detection exercises

The Navy will conduct several mitigation measures within pre-defined boundaries of a North Atlantic right whale mitigation area off the southeast United States during calving season between 15 November and 15 April. The southeast United States mitigation area is defined as follows (and depicted in Figure 3.4-1): a 5 nm buffer around the coastal waters between 31°15' North and 30°15' North from the coast out 15 nm; and the coastal waters between 30°15' North and 28°00' North from the coast out 5 nm.

Before transiting through or conducting any training or testing activities within the mitigation area, the Navy will initiate prior 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 of the mitigation area to help vessels and aircraft reduce potential interactions with North Atlantic right whales. Commander Submarine Force U.S. Atlantic Fleet will coordinate any submarine operations that may require approval from the Fleet Area Control and Surveillance Facility, Jacksonville.

When transiting within the mitigation area, all Navy vessels will exercise extreme caution and proceed at the slowest speed that is consistent with safety, mission, training, and operations. 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 at night or during periods of poor visibility. The Navy will minimize to the maximum extent practicable north-south transits through the mitigation area. Consistent with current mitigation, the Navy may periodically travel in a north-south direction during training and testing activities due to operational requirements. If north-south directional travel is required during training or testing activities, the Navy will continue to implement the increased caution and speed reductions described above when applicable.

Effectiveness and Operational Assessments

The waters off the southeastern United States are the only known calving grounds for the North Atlantic right whale. The Early Warning System is a comprehensive aerial survey effort conducted off the southeast United States to approximately 30–35 nm offshore during the North Atlantic right whale calving season. Sponsored collaboratively by the Navy, U.S. Coast Guard, U.S. Army Corps of Engineers, and NMFS, aerial surveys are flown daily from December 1–March 31, weather permitting. Aerial surveys are conducted to sight North Atlantic right whales and to relay the sighting information to mariners transiting within the North Atlantic right whale calving ground. The information exchange network includes the Fleet Area Control and Surveillance Facility, Jacksonville; Commander, Naval Submarine Forces, Norfolk, Virginia; and Naval Submarine Support Command.

The Navy proposes implementing the recommended measures described above because (1) they are likely to result in avoidance or reduction of injury to the North Atlantic right whale, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.3.1.1.2 North Atlantic Right Whale Northeast Foraging Habitat

Recommended Mitigation and Comparison to Current Mitigation

As background, two important North Atlantic right whale foraging habitats, the Great South Channel and Cape Cod Bay, are located off the northeast United States (Figure 3.4-1). These two areas comprise the northeast United States mitigation area, which applies year-round and is defined as follows:

- Great South Channel: The area bounded by 41°40' North / 69°45' West; 41°00' North / 69°05' West; 41°38' North / 68°13' West; and 42°10' North / 68°31' West
- Cape Cod Bay: The area bounded by 42°04.8' North / 70°10' West; 42°12' North / 70°15' West; 42°12' North / 70°30' West; 41°46.8' North / 70°30' West and on the south and east by the interior shoreline of Cape Cod, Massachusetts

To supplement the mitigation measures described in Section 5.3.2 (Mitigation Zone Procedural Measures), the Navy is proposing to (1) continue implementing year-round measures within the North Atlantic right whale mitigation area off the northeast United States, (2) clarify the torpedo (non-explosive) testing visual observation requirements, (3) clarify the conditions needed to recommence an activity after a sighting, and (4) remove the requirement for operators to submit a written request to U.S. Fleet Forces Command for permission prior to conducting hull-mounted surface and submarine active sonar training or helicopter dipping in the mitigation area (these activities are not expected to occur in the area as part of the Proposed Action). The recommended measures are provided below.

The Navy will not conduct the following activities within the boundaries of the mitigation area or within additional specified distances from the mitigation area:

- Improved Extended Echo Ranging sonobuoy exercises in or within 3 nm of the mitigation area
- Bombing exercises (explosive and non-explosive)
- Underwater detonations
- Torpedo exercises (explosive)

The Navy will minimize to the maximum extent practicable the use of the following systems within the boundaries of the mitigation area:

- Low-frequency and hull-mounted mid-frequency active sonar
- High-frequency and non-hull mounted mid-frequency active sonar, including helicopter dipping

Before transiting the mitigation area with a vessel, the Navy will conduct a prior web query or email inquiry to the National Oceanographic and Atmospheric Administration Fisheries Service Northeast United States Right Whale Sighting Advisory System in order to obtain the latest North Atlantic right whale sighting information. When transiting within the mitigation area, vessels will exercise extreme caution and proceed at the slowest speed that is consistent with safety, mission, training, and operations. 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 week, when operating at night, or during periods of poor visibility. These additional speed reductions will be implemented per Rule 6 of International Navigational Rules.

Additional mitigation will be implemented during torpedo (non-explosive) testing: (1) ships will maintain a speed of no more than 10 knots (19 km/hour) during transit, and (2) ship speeds will range from 10 knots (19 km/hour) during normal firing; 18 knots (33.3 km/hour) during submarine target firing; and in excess of 18 knots (33.3 km/hour) during vessel target firing (speeds in excess of 18 knots will occur for a short time [e.g., 10–15 min.]). The Navy will conduct all torpedo (non-explosive) testing during daylight hours in Beaufort sea states of 3 or less to increase the probability of marine mammal detection. Mitigation will include visual observation immediately before and during the exercise within the vicinity of the activity. The Navy will have three Lookouts during torpedo (non-explosive) testing activities (one positioned on a vessel and two in an aircraft during dedicated aerial surveys). An additional Lookout will be positioned on the submarine, when surfaced. Visual observation from the vessels and aircraft will occur immediately prior to and during the activity. Current mitigation requires that aerial observation be conducted from an aircraft with an overhead wing. The Navy is proposing to modify this measure to allow for the aerial observation to be conducted from any aircraft type that would be consistent with established aerial survey protocol. The Navy is also proposing to remove the seasonal restriction and designated training areas in order to allow activities to occur year-round throughout the mitigation area. Currently there are five designated areas within and adjacent to the mitigation area where torpedo (non-explosive) activities may occur. Based on the Proposed Action, torpedo (non-explosive) testing activities will typically continue to be conducted within these established areas. The test scenario will not commence if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the vicinity of the activity. The test scenario will cease if a marine mammal is sighted within the vicinity of the activity. The test scenario will recommence if any one of the following conditions is met: (1) the animal is observed exiting the vicinity of the activity, (2) the animal is thought to have exited the mitigation zone based on a determination of its course and speed and the relative motion between the animal and the source, or (3) the vicinity of the activity has been clear from any additional sightings for a period of 30 min.

<u>Effectiveness and Operational Assessments</u>

Important habitats or congregation areas for North Atlantic right whales include the coastal waters of the Great South Channel, Georges Bank/Gulf of Maine, and Cape Cod and Massachusetts Bays. New England waters are an important feeding habitat for right whales due to the dense zooplankton patches, particularly during the spring, summer, and fall. The consistency with which the North Atlantic right whale occurs at its northern feeding grounds is relatively high (Waring et al. 2010). The Right Whale Sighting Advisory System is a National Oceanographic and Atmospheric Administration Fisheries program that collects sightings information off the northeastern United States from aerial surveys, shipboard surveys, whale watch vessels, and opportunistic sources, such as the U.S. Coast Guard, commercial ships, fishing vessels, and the general public.

The Navy is proposing to modify the current seasonal and geographic restrictions for torpedo (non-explosive) testing activities. The current restrictions for torpedo (non-explosive) testing activities are resulting in unacceptable impacts on military readiness because they limit the ability to test new torpedoes or modifications to existing torpedo systems when assets and testing locations are available. All torpedo testing is part of a Navy program development plan and any delay in testing results in a delay in delivery of a war fighting capability requirement to the Fleet. Inability to use assets and testing locations as they become available results in an adverse impact on readiness by (1) resulting in a significant additional annual cost (both in time and personnel associated with program development) to the testing process, (2) adding significant logistical complications, as torpedo testing is largely dependent upon Fleet asset availability, and current restrictions reduce the Navy's availability to obtain assets for testing during this short operational window, and (3) delaying the Navy's ability to complete required testing, finalize associated training materials, and complete training of relevant personnel. Ultimately, these adverse impacts are degrading readiness in that they hinder the Navy's operational platforms from operating at maximum capability against enemy threats. The Navy will continue to conduct most torpedo (non-explosive) testing activities within the currently established torpedo testing areas; however, full seasonal and geographic flexibility is needed in order to prevent unacceptable impacts on readiness.

Requiring the submission of written requests prior to conducting a training or testing activity limits the number of requests that are received, and ultimately reduces the number of activities that could occur in a particular area, such as the North Atlantic right whale foraging habitat off the northeastern United States. However, low-frequency and hull-mounted active sonar training and helicopter dipping activities are not expected to be conducted in this particular area as part of the Proposed Action. As such, the requirement to submit written requests for these activities is no longer needed.

The Navy proposes implementing the recommended measures described above because (1) they are likely to result in avoidance or reduction of injury to the North Atlantic right whale, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.3.1.1.3 North Atlantic Right Whale Mid-Atlantic Migration Corridor

Recommended Mitigation and Comparison to Current Mitigation

A North Atlantic right whale migratory route is located off the mid-Atlantic coast of the United States. To supplement the mitigation measures described in Section 5.3.2 (Mitigation Zone Procedural Measures), the Navy is proposing to (1) continue implementing additional measures within the North Atlantic right whale mid-Atlantic migration corridor, and (2) modify the definition of the geographic coordinates and dates of the currently implemented mitigation area to match the NMFS guidance for right whale ship strike reduction (National Marine Fisheries Service 2008). The recommended measures are provided below.

This mitigation area applies from November 1 through April 30 and is defined as follows:

- Block Island Sound: The area bounded by 40°51'53.7" North / 070°36'44.9" West; 41°20'14.1" North / 070°49'44.1" West
- New York and New Jersey: 20 nm seaward of the line between 40°29'42.2" North / 073°55'57.6" West
- Delaware Bay: 38°52'27.4" North / 075°01'32.1" West
- Chesapeake Bay: 37°00'36.9" North / 075°57'50.5" West

- Morehead City, North Carolina: 34°41'32.0" North / 076°40'08.3" West
- Wilmington, North Carolina, through South Carolina, and to Brunswick, Georgia: Within a continuous area 20 nm from shore and west back to shore bounded by 34°10'30" North / 077°49'12" West; 33°56'42" North / 077°31'30" West; 33°36'30" North / 077°47'06" West; 33°28'24" North / 078°32'30" West; 32°59'06" North / 078°50'18" West; 31°50'00"North / 080°33'12" West; 31°27'00" North / 080°51'36" West

When transiting within the migration corridor, the Navy will practice increased vigilance, exercise extreme caution, and proceed at the slowest speed that is consistent with safety, mission, and training and testing objectives.

Effectiveness and Operational Assessments

Major habitats or congregation areas for North Atlantic right whales include the coastal waters of the southeastern United States, the Great South Channel, Georges Bank/Gulf of Maine, and Cape Cod and Massachusetts Bays. Movements within and between these habitats are extensive (Waring et al. 2010). The Early Warning System and Right Whale Sighting Advisory System sightings data do not extend throughout the North Atlantic right whale migration corridor. Therefore, when transiting within the migration corridor, the Navy's increased vigilance, proceeding at the slowest speed that is consistent with safety, mission, training, and operations will likely reduce the potential for Navy vessels to interact with North Atlantic right whales during seasonal migrations in the absence of more comprehensive sightings information data.

The Navy proposes implementing the recommended measures described above because (1) they are likely to result in avoidance or reduction of injury to the North Atlantic right whale, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.3.1.2 West Indian Manatee

5.3.3.1.2.1 Manatee Habitat Near Mayport, Florida

Recommended Mitigation and Comparison to Current Mitigation

Information on protective measures pertaining to activities not conducted under the Proposed Action is contained in the Integrated Natural Resources Management Plan for Naval Station Mayport. This mitigation area is located within the basin and channels at Naval Station Mayport in Jacksonville, Florida. To supplement the mitigation measures described in Section 5.3.2 (Mitigation Zone Procedural Measures), the Navy is proposing to continue implementing additional measures in this area. The recommended measures are provided below.

Within the turning basin, basin entrance channel, and all other waterways adjacent to these water bodies at Naval Station Mayport in Jacksonville, Florida, Navy vessels will comply with all federal, state, and local Manatee Protection Zones and reduce speed in accordance with established operational safety and security procedures. 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 Station provides training to Harbor Operations personnel to report manatee observations to other vessels in the basin and posts signs at select locations alerting personnel of the potential presence of manatees and the requirements and procedures for reporting manatee sightings.

Effectiveness and Operational Assessments

Vessel collisions are the primary cause of injury and death to West Indian manatees. The U.S. Fish and Wildlife Service and the Florida Fish and Wildlife Conservation Commission Manatee Protection Zones are designed to reduce this threat by limiting speeds within designated areas, including certain basins and channels of the Study Area. The Navy's adherence to all federal, state, and local Manatee Protection Zones and participation in the manatee sighting communication system within basins and channels of the Study Area will help reduce the potential for collision with West Indian manatees.

The Navy proposes to implement the recommended measure described above because (1) it is likely to result in avoidance or reduction of injury to the manatee, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.3.1.2.2 Manatee Habitat Near Port Canaveral, Florida

Recommended Mitigation and Comparison to Current Mitigation

This mitigation area is located within the bay of Port Canaveral, Florida. To supplement the mitigation measures described in Section 5.3.2 (Mitigation Zone Procedural Measures), the Navy is proposing to continue implementing additional measures in this area. The recommended measures are provided below.

The Navy will notify the Port Authority prior to the commencement of pierside sonar testing activities. Pierside sonar testing will only occur during daylight hours to ensure adequate sightability of marine mammals and sea turtles. To facilitate observations, Lookouts will be equipped with polarized sunglasses. The Navy will have a minimum of four Lookouts to conduct visual observations for marine mammals and sea turtles (bins MF8, MF9, MF10, and MF12 only) immediately prior to the start of, during, and for 30 min. after the completion of pierside sonar testing activities. Applicable mitigation zones and post-sighting activity recommencement conditions for pierside sonar testing activities are described in Section 5.3.2.1.1.1, Low-frequency and Hull-mounted Mid-frequency Active Sonar.

Effectiveness and Operational Assessments

In the Study Area, the West Indian manatee's primary range extends along both the Atlantic and gulf coasts of Florida. The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of injury to manatees and sea turtles, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.3.1.2.3 Manatee Habitat Near Kings Bay, Georgia

Recommended Mitigation and Comparison to Current Mitigation

Information on protective measures pertaining to activities not conducted under the Proposed Action is contained within the Naval Submarine Base Kings Bay Integrated Natural Resources Management Plan. This mitigation area is located within Kings Bay, Georgia. To supplement the mitigation measures described in Section 5.3.2 (Mitigation Zone Procedural Measures), the Navy is proposing to continue implementing additional measures in this area. The recommended measures are provided below.

When mooring pierside, the Navy will ensure proper fendering techniques (e.g., the use of buoys that keep submarines 20 ft. [6 m.] off of the quay wall) to prevent submarines from injuring a manatee. The Navy will notify the Port Authority prior to the commencement of pierside sonar testing activities. Source level reductions in pierside testing are standard protocol, and a reduction of a minimum of 36 dB from full power for mid-frequency active sonar transmissions at Kings Bay will be implemented. Pierside sonar testing will only occur during daylight hours to ensure adequate sightability of marine mammals and sea turtles. To facilitate observations, Lookouts will be equipped with polarized sunglasses. The Navy will have a minimum of four Lookouts to conduct visual observations for marine mammals and sea turtles (bins MF8, MF9, MF10, and MF12 only) immediately prior to the start of, during, and for 30 min. after the completion of pierside sonar testing activities. Applicable mitigation zones and post-sighting activity recommencement conditions for pierside sonar testing activities are described in Section 5.3.2.1.1.1, Low-frequency and Hull-mounted Mid-frequency Active Sonar.

As part of the Early Warning Communication System, information regarding all sightings of manatees and sea turtles (e.g., information on the time and location of sighting, number and size of animals sighted, description of the tag if present, and direction of travel) will be communicated to Port Operations for information dissemination to other vessels operating in the vicinity of the sighting. This information will also be communicated to the Georgia Department of Natural Resources sightings hotline and the Base Natural Resources Manager. Port Operations will keep a sightings log of all manatee sightings.

Effectiveness and Operational Assessments

The Atlantic Coast subpopulation of manatee occurs along the Atlantic coast of Georgia and Florida. Manatees are most frequently sighted in the vicinity of Kings Bay from April through July, but have also been sighted in the winter months. The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of injury to manatees and sea turtles, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.3.1.2.4 Manatee Habitat Near Camp Lejeune, North Carolina

Recommended Mitigation and Comparison to Current Mitigation

As described in Section 2.8 (Alternative 2: Includes Alternative 1 Plus Increased Tempo of Training and Testing Activities), elevated causeway system pile driving activities could occur up to once per year at either the VACAPES Range Complex (Joint Expeditionary Base, Little Creek and Fort Story) location or Cherry Point Range Complex (Camp Lejeune) location. As described in Section 5.3.1.2.2.16 (Elevated Causeway System – Pile Driving) and Section 5.3.2.1.2.16 (Elevated Causeway System – Pile Driving), the Navy is proposing to add mitigation measures for elevated causeway system pile driving activities regardless of the activity location. For reference, the recommended measures include having one Lookout (positioned on the platform that will maximize the potential for sightings, which could include the shore, an elevated causeway, or a small boat) conduct visual observations starting 30 min. prior to and during the exercise within a mitigation zone of 60 yd. (55 m) around the pile driver. The exercise will not commence if concentrations of floating vegetation (*Sargassum* or kelp paddies) are observed in the mitigation zone. Pile driving will cease if a marine mammal or sea turtle is sighted within the mitigation zone. Pile driving will recommence if any one of the following conditions is 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 and speed and the relative motion between the animal and the source, or (3) the mitigation zone has been clear from any additional sightings for a period of 30 min.

Mitigation measures specific to manatees during elevated causeway system pile driving activities do not currently exist. To supplement the mitigation measures summarized above that apply to all marine mammals, the Navy is proposing to add the recommended measures provided below for the purpose of further protecting manatees during this activity when conducted near Camp Lejeune, North Carolina.

Prior to elevated causeway system pile driving activities near Camp Lejeune, the Navy project manager or civilian equivalent will inform all personnel associated with the project that manatees may be present in the project area, and the need to avoid any harm to these endangered marine mammals. The Navy project manager or civilian equivalent will ensure that all construction personnel know the general appearance of the species and their behaviors, which may include being completely or partially submerged in shallow water. All construction personnel will be informed that they are responsible for observing water-related activities for the presence of manatees. The Navy project manager or civilian equivalent will advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing manatees, which are protected under the MMPA and the ESA.

As described in Section 5.5.2.4 (Marine Mammal Incident Reporting), the Navy will immediately report any injury to a manatee to the U.S. Fish and Wildlife Service (by calling 919.856.4520 ext. 28), NMFS (by calling 252.728.8762), and the North Carolina Wildlife Resources Commission (by calling 252.448.1546). Additionally, the Navy will maintain a log detailing all sightings and injuries to manatees during pile driving activities. 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 U.S. Fish and Wildlife Service, Raleigh Field Office.

Effectiveness and Operational Assessments

In the Study Area, the West Indian manatee's secondary range includes the coastal waters of North Carolina. The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of injury to manatees and sea turtles, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.3.1.3 Cetaceans (General)

5.3.3.1.3.1 Planning Awareness Areas

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to (1) continue the currently implemented measures within the existing planning awareness areas, and (2) extend the boundary of the eastern Gulf of Mexico planning awareness area to encompass the draft Bryde's whale Biologically Important Area. The recommended measures are provided below.

For events involving active sonar, the Navy will avoid planning major exercises in the planning awareness areas where feasible. To the extent operationally feasible, the Navy will not conduct more than one of the four major exercises or similar scale events per year in the Gulf of Mexico planning awareness areas. If national security needs require conducting more than four major exercises or similar scale events in the planning awareness areas per year, or more than one within the Gulf of Mexico planning awareness areas per year, the Navy will provide NMFS with prior notification and include the information in any associated exercise or monitoring reports.

Effectiveness and Operational Assessments

The Navy has designated several planning awareness areas based on areas of high productivity that have been correlated with high concentrations of marine mammals (e.g., persistent oceanographic features such as upwellings associated with the Gulf Stream front where it is deflected off the east coast near the

Outer Banks of North Carolina), and areas of steep bathymetric contours that are frequented by deep-diving marine mammals (e.g., beaked whales and sperm whales).

As part of the ESA and MMPA processes, NMFS requested that the Navy consider some specific preliminary draft Biologically Important Areas as part of its mitigation analysis. As a result of the Navy's Biological Assessment and Operational Assessment, the Navy recommends extending the boundary of the eastern Gulf of Mexico planning awareness area to further protect a population of Bryde's whale that has been exclusively observed in that area year-round. Surveys of Bryde's whales throughout the Gulf of Mexico suggest that the Biologically Important Area could potentially be more important for this species than any other area within the Gulf of Mexico. The existing planning awareness areas and expanded area are depicted in Figure 5.3-1.

Within the Study Area, the Navy is not tied to a specific range support structure for the majority of its training requirements. Additionally, the topography and bathymetry along the east coast and in the Gulf of Mexico is unique in that there is a wide continental shelf leading to the shelf break affording a wider range of training opportunities. Avoiding planning major training exercises in these areas will help avoid any subsequent potential impacts on marine mammals from these activities in these specific areas.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of injury to marine mammals, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.3.2 Seafloor Resources

5.3.3.2.1 Marine Habitats and Cultural Resources

5.3.3.2.1.1 Shallow Coral Reefs, Hard Bottom Habitat, Artificial Reefs, and Shipwrecks

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to (1) modify some of the mitigation measures for seafloor habitats and shipwrecks, (2) discontinue the currently implemented measures for medium- and large-caliber gunnery exercises and missile exercises using airborne targets, and (3) add a mitigation requirement for at-sea explosive testing. The recommended measures are provided below. These measures will be implemented wherever applicable throughout the entire AFTT Study Area.

To aid in the implementation of these measures, the Navy will include maps of surveyed shallow coral reefs, artificial reefs, shipwrecks, and live hard bottom in the Protective Measures Assessment Protocol. For mitigation, the term "surveyed" refers to bottom features where the available data indicate the natural boundary of the feature at a generally constant accuracy. Data that are generalized within large geometric areas (e.g., grid cells) are not included. Point and transect data will also be included if actual moderate- to high-relief hard bottom is being documented. This criterion excludes some data (e.g., grid-based hard bottom polygons and indicator fish transects).

The shipwreck data documented in Section 3.3 (Marine Habitats) were refined to only accurate positions using the following criteria: (1) not an obstruction, sounding, unknown (non-wreck), dump site, mooring buoy, sewer outfall, piling, or rock; (2) high or medium accuracy location; (3) not disproved; (4) not an approximate position (applied to medium accuracy only); and (5) source information provided.

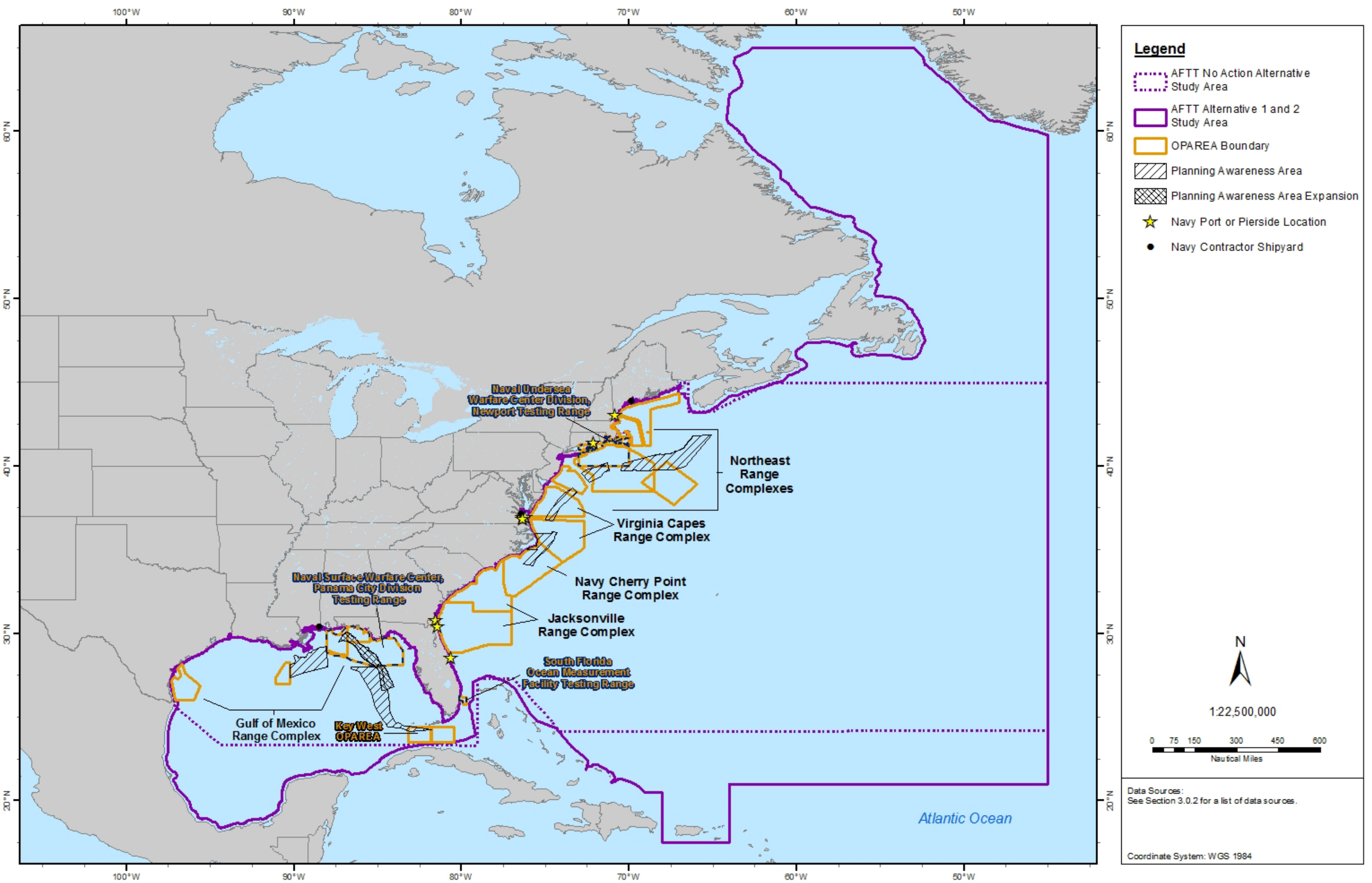

Figure 5.3-1: Navy Planning Awareness Areas

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

The Navy will not conduct precision anchoring within the anchor swing diameter, or explosive mine countermeasure and neutralization activities within 350 yd. (320 m) of surveyed shallow coral reefs, live hard bottom, artificial reefs, and shipwrecks.

The Navy will not conduct explosive or non-explosive small-, medium-, and large-caliber gunnery exercises using a surface target; explosive or non-explosive missile exercises using a surface target; explosive or non-explosive bombing exercises; or at-sea explosive testing within 350 yd. (320 m) of surveyed shallow coral reefs.

Effectiveness and Operational Assessments

The Navy's currently implemented seafloor habitats and shipwreck mitigation zones are based off the range to effects for marine mammals or sea turtles, which are driven by hearing thresholds. The Navy's recommended measures are modified to focus on reducing potential physical impacts on seafloor habitats and shipwrecks from explosives and physical strike from military expended materials. The recommended 350-yd. (320-m) mitigation zone is based off the estimated maximum seafloor impact zone for explosions discussed in Section 3.3 (Marine Habitats). The use of non-explosive military expended materials would result in a smaller footprint of potential impact; however, the Navy recommends applying the explosive mitigation zone to all explosive and non-explosive activities as listed above for ease of implementation. This standard mitigation zone will consequently result in an additional protection buffer during the non-explosive activities listed above.

It is not possible to definitively predict or to effectively monitor where the military expended materials from airborne gunnery and missile exercises using aerial targets would be likely to strike seafloor habitats and shipwrecks. The potential debris fall zone can only be predicted within tens of miles for long range events, which can be in excess of 80 nm from the firing location during some missile exercises, and thousands of yards for shorter events, which can occur within several thousand yards of the firing location.

Live hard bottom, shallow water coral reefs, artificial reefs, and shipwrecks fulfill important ecosystem functions. Avoiding or minimizing physical disturbance and strikes of these resources will likely reduce the impact on these resources. This measure is only effective with regard to surveyed resources since the Navy needs specific locations to restrict the specified activities. It is not possible for the Navy to avoid these seafloor features when their exact locations are unknown.

The Navy proposes implementing the recommended measures described above because (1) they are likely to result in avoidance or reduction of physical disturbance and strikes to seafloor habitats and shipwrecks, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.3.2.1.2 Live Hard Bottom and Shallow Coral Reefs Within South Florida Ocean Measurement Facility

Recommended Mitigation and Comparison to Current Mitigation

The Navy is proposing to 1) continue the South Florida Ocean Measurement Facility Testing Range measures as currently implemented for installation, deployment, and recovery of anchors and mine-like objects, and 2) add measures for use of bottom crawling unmanned underwater vehicles. Currently, measures do not exist for bottom crawling unmanned underwater vehicles. The recommended measures are provided below.

Anchors and Mine-like Objects

Installation of anchors and mine-like objects are conducted using real-time geographic information system and global positioning system, along with groundtruth and verification support, which will help the Navy avoid sensitive marine species and communities during deployment, installation, and recovery. The following procedures will be followed:

- Mooring (anchors and mine-like objects) placement locations would be identified in advance to minimize at-sea mission time and navigation.
- The deployment vessel will hold a relatively fixed position over the work area using a dynamic positioning navigation system with global positioning system.
- Vessel movement and drift will be minimized to ensure that the proposed mooring installation plan is followed with limited deviation.
- Construction work vessels will not anchor or spud over coral, coral reef, and hard bottom habitat.
- Semi-permanent anchoring that was surveyed and installed clear of sensitive resources will be used. These anchoring systems will be assisted with riser buoys to prohibit contact of the mooring cable with the sea floor.
- All watercraft associated with the construction and use of the permitted structures will only operate within waters of sufficient depth so as to preclude bottom scouring or prop dredging. Specifically, there shall be a minimum 12-in. clearance between the deepest draft of the vessel (with the motor in the down position) and the bottom substrate at mean low water.
- Operations will only be conducted when sea and wind conditions allow the vessels to maintain maximum position and speed control.

Bottom Crawling Unmanned Underwater Vehicles

Deployment of the bottom crawling unmanned underwater vehicles would mainly occur in waters less than 9.8 ft. (3 m) in depth. However, if deployment is necessary greater than 9.8 ft. (3 m) in depth, it will be conducted using real-time geographic information system and global positioning system, along with groundtruth and verification support, which will help the Navy avoid sensitive marine species and communities. In addition, any of the procedures for anchors and mine-like objects that are applicable to deployment and recovery of bottom crawling unmanned underwater vehicles will be followed.

Effectiveness and Operational Assessments

Live hard bottom and shallow water coral reefs fulfill important ecosystem functions. Avoiding or minimizing physical disturbance and strikes of these resources will reduce the impact on these resources.

The Navy proposes implementing the recommended measures described above because (1) they are likely to result in avoidance or reduction of physical disturbance and strikes to live hard bottom and shallow coral reefs, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.3.3 Reptiles

5.3.3.3.1 Sea Turtles

5.3.3.3.1.1 Sea Turtle Habitat off Panama City, Florida

Recommended Mitigation and Comparison to Current Mitigation

To supplement the mitigation measures described in Section 5.3.2 (Mitigation Zone Procedural Measures), the Navy is proposing to (1) modify the definition of nesting season to be from March through September (i.e., adding March and April), (2) modify the time of day requirement for conducting ordnance testing – line charge testing at Naval Surface Warfare Center, Panama City Division Testing Range, and (3) eliminate the requirement to avoid conducting electromagnetic mine countermeasure and neutralization activities within 32 yd. (30 m) of shore during sea turtle nesting season at Naval Surface Warfare Center, Panama City Division Testing Range. For reference, the Navy currently defines the nesting season as May through September. The recommended measures are provided below.

The Navy will avoid conducting ordnance testing – line charge testing activities at Naval Surface Warfare Center, Panama City Division Testing Range at night from March through September.

Effectiveness and Operational Assessments

Kemp's ridley sea turtles have a nesting season that extends from April through June (U.S. Fish and Wildlife Service 2001b). Kemp's ridley sea turtles nest in low numbers along the northern Texas, Alabama, and Florida coasts (fewer than 10 nests per year). Green sea turtle nesting season extends from June through September from the coasts of Florida to the Carolinas (U.S. Fish and Wildlife Service 2001a). Loggerhead nesting season extends from May through August from the coast of Texas to Virginia (U.S. Fish and Wildlife Service 2001d). Leatherback nesting season extends from March through July from the coast of Texas to the Carolinas (U.S. Fish and Wildlife Service 2001c). The Navy proposes extending the sea turtle nesting season definition to be from March through September (adding March and April) to account for the full leatherback sea turtle nesting season.

The designated line charge testing location on Santa Rosa Island within the Naval Surface Warfare Center, Panama City Division Testing Range is currently the Navy's only location capable of supporting this type of activity. The seasonal restriction is preventing the Navy from conducting line charge testing activities for 5 months out of the year, which is resulting in an unacceptable impact on military readiness and increased risk to personnel safety. The seasonal restriction is eliminating opportunities to test the capabilities of line charge testing munitions to safely clear surf zone areas for sea-based expeditionary operations. The Navy needs the flexibility to conduct these tests year-round in order to meet changing operational timelines and combat deployment schedules.

Avoidance of ordnance testing – line charge testing activities at Naval Surface Warfare Center, Panama City Division Testing Range at night from March through September is likely to 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. As discussed in Section 5.3.2.1.2.14 (Ordnance Testing – Line Charge Testing), the Navy will visually observe for sea turtles immediately before and during the activity.

The Navy is proposing to eliminate the measure to avoid conducting electromagnetic mine countermeasure and neutralization activities within 32 yd. (30 m) of shore during sea turtle nesting season at Naval Surface Warfare Center, Panama City Division Testing Range due to the environmental consequences analysis suggesting that impacts are not expected on sea turtles from electromagnetic activities. Therefore, this measure would not be necessary for avoiding or reducing potential environmental impacts.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of injury to sea turtles, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.3.3.1.2 Sea Turtle Habitat off North Carolina

Recommended Measure and Comparison to Current Mitigation

To supplement the mitigation measures described in Section 5.3.2 (Mitigation Zone Procedural Measures), during mine countermeasure and neutralization activities using positive control diver-placed charges and mine neutralization activities using diver-placed time-delay firing devices, the Navy is proposing to (1) clarify the applicable season for the currently implemented measure during sea turtle nesting season within the Navy Cherry Point Range Complex, and (2) discontinue the requirement that detonations are not allowed within 3.2 nm of an estuarine inlet and within 1.6 nm of shoreline for the VACAPES or JAX Range Complexes. The recommended measures are provided below.

Within the Navy Cherry Point Range Complex, the Navy will not conduct mine countermeasure and neutralization activities using positive control diver-placed charges and mine neutralization activities using diver-placed time-delay firing devices within 3.2 nm of an estuarine inlet and within 1.6 nm of the shoreline from March through September.

Effectiveness and Operational Assessments

The measure regarding distance from shore was initially established for mine countermeasure and neutralization activities using positive control diver-placed charges and was intended to reduce potential impacts on nesting sea turtles and hatchlings that may be close to shore. These activities are not typically conducted within 3.2 nm of an estuarine inlet and within 1.6 nm of the shoreline within the VACAPES or JAX Range Complexes, so mitigation is not typically needed in those areas. However, flexibility is necessary due to these activities being conducted with the use of small boats that would typically leave from a coastal inlet and operate in nearshore waters. Although sea turtle nesting does occur along the coast of Virginia, it is mainly concentrated further south along the coast of Florida and in the Gulf of Mexico. In the rare instance that a mine countermeasure and neutralization activity would occur within the specified distance from shore within the VACAPES and JAX Range Complexes, the mitigation zone measures would help reduce the potential impacts on sea turtles that are available to be observed (Section 5.3.2.1.2.4, Mine Countermeasure and Neutralization Activities Using Positive Control Firing Devices and Section 5.3.2.1.2.5, Mine Neutralization Activities Using Diver-Placed Time-Delay Firing Devices). The Navy proposes discontinuing the measures within the VACAPES and JAX Range Complexes because the measures would not be necessary for avoiding or reducing the potential of injury to sea turtles. The Navy recommends continuing the measure during sea turtle nesting season within the Navy Cherry Point Range Complex due to the proximity to the Onslow Beach sea turtle sanctuary.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of injury to sea turtles, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.3.4 Birds

5.3.3.4.1 Piping Plovers

5.3.3.4.1.1 Piping Plover Breeding Habitat in Virginia

Recommended Mitigation and Comparison to Current Mitigation

To supplement the mitigation measures described in Section 5.3.2 (Mitigation Zone Procedural Measures), the Navy is proposing to (1) continue implementing additional measures near piping plover breeding habitat in Virginia. The recommended measures are provided below.

Within the VACAPES Range Complex, during mine countermeasure and neutralization activities using positive control diver-placed charges and mine neutralization activities using diver-placed time-delay firing devices, helicopters will remain at least 1 nm from the beach except when transiting offshore. When transiting from Norfolk Naval Station to offshore, helicopters will avoid overflying Fisherman Island National Wildlife Refuge off the coast of Cape Charles, Virginia by at least 3,000 ft. (914 m) vertically and horizontally to avoid disturbing piping plovers and other birds.

Effectiveness and Operational Assessments

The Eastern Shore of Virginia's barrier islands serve as important breeding habitat for the ESA-listed piping plover. Due to the location of Fisherman Island National Wildlife Refuge to Norfolk Naval Station, piping plovers and other seabirds could potentially be exposed to aircraft overflights as aircraft transit offshore. The helicopter measures recommended during mine countermeasure and neutralization activities using positive control diver-placed charges and mine neutralization activities using diver-placed time-delay firing devices within the VACAPES Range Complex and near Fisherman Island National Wildlife Refuge will likely reduce the potential to disturb piping plovers and other birds within this breeding habitat.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of injury to piping plovers, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.3.5 Fish

5.3.3.5.1 Gulf Sturgeon

5.3.3.5.1.1 Gulf Sturgeon Habitat in the Gulf of Mexico

Recommended Mitigation and Comparison to Current Mitigation

The Gulf sturgeon mitigation area, which is modeled after the species' critical habitat (depicted in Figure 3.9-3), is defined as nearshore Gulf of Mexico waters in Escambia, Santa Rosa, Okaloosa, Walton, Bay, and Gulf counties in Florida from the shoreline to 1 mi. (1.6 km) offshore. The mitigation area includes migration habitat for Gulf sturgeon en route from Gulf of Mexico winter and feeding grounds to their spring and summer natal (hatching) rivers (the Yellow, Choctawhatchee, and Apalachicola Rivers). To supplement the mitigation measures described in Section 5.3.2 (Mitigation Zone Procedural Measures), the Navy is proposing to (1) continue implementing ordnance testing – line charge testing restrictions within the Gulf sturgeon mitigation area, and (2) eliminate the seasonal limitation at one designated location in order to allow ordnance testing – line charge testing to occur year-round on Santa Rosa Island. For reference, the Navy does not currently conduct ordnance testing – line charge testing activities in the mitigation area between October and March. The recommended measures are provided below.

The Navy will not conduct ordnance testing – line charge testing activities in the mitigation area between October and March (except within the designated location on Santa Rosa Island).

Effectiveness and Operational Assessments

Santa Rosa Island is located within the Naval Surface Warfare Center, Panama City Division Testing Range. The designated line charge testing location on Santa Rosa Island is currently the Navy's only location capable of supporting this type of activity. The seasonal restriction is preventing the Navy from conducting line charge testing activities for 6 months out of the year, which is resulting in an unacceptable impact on military readiness and increased risk to personnel safety. The seasonal restriction is eliminating opportunities to test the capabilities of line charge testing munitions to safely clear surf zone areas for sea-based expeditionary operations. The Navy needs the flexibility to conduct these tests year-round in order to meet changing operational timelines and combat deployment schedules.

Avoidance of ordnance testing – line charge testing activities within the mitigation area (except within the designated location on Santa Rosa Island) is likely to reduce potential impacts on the Gulf sturgeon during the species' migration. As discussed in Section 5.3.2.1.2.14 (Ordnance Testing – Line Charge Testing), during testing at Santa Rosa Island, activity in the surf zone (e.g., deployment of the line charges) prior to commencement of the detonation will likely result in Gulf sturgeon leaving the immediate area of their own volition, which will further reduce potential impacts on the species.

The Navy proposes implementing the recommended measure described above because (1) it is likely to result in avoidance or reduction of exposure to high levels of energy to the Gulf sturgeon, and (2) implementation has been analyzed as acceptable with regard to personnel safety, practicality of implementation, impact on effectiveness of the military readiness activity, and Navy policy.

5.3.4 Mitigation Measures Considered but Eliminated

A number of mitigation measures were suggested during the public comment periods of previous Navy environmental documents and throughout the development of this Final EIS/OEIS. As a result of the assessment process identified in Section 5.2 (Introduction to Mitigation), the Navy determined that some of the suggested measures would likely be ineffective at reducing environmental impacts, have an unacceptable operational impact based on the operational assessment, or be incompatible with Section 5.2.2 (Overview of Mitigation Approach). The measures that the Navy does not recommended for implementation are discussed in Section 5.3.4.1 (Previously Considered but Eliminated) and Section 5.3.4.2 (Previously Accepted but Now Eliminated). There is a distinction between effective and feasible observation procedures for data collection, and measures employed to prevent impacts or otherwise serve as mitigation. The discussion below is in reference to those procedures meant to serve as mitigation measures.

5.3.4.1 Previously Considered but Eliminated

5.3.4.1.1 Reducing Amount of Training and Testing Activities

Reducing training and testing for the purpose of mitigation would result in an unacceptable impact on readiness for the following reasons:

The requirements to train are designed to provide the experience needed to ensure Sailors are properly prepared for operational success. Training requirements have been developed through many years of iteration and are designed to ensure Sailors achieve the levels of readiness needed to properly respond to the many contingencies that may occur during an actual mission. The Proposed Action does not include training beyond levels required for maintaining satisfactory levels of readiness due to the need to efficiently use limited resources (e.g., fuel, personnel, and time). Therefore, any reduction of training would not allow Sailors to achieve satisfactory levels of readiness needed to accomplish their mission.

The requirements to test systems prior to their implementation in military activities are identified in Department of Defense (DoD) Directive 5000.1. This directive states that test and evaluation support is to be integrated throughout the defense acquisition process. The Navy rigorously collected data during the developmental stages of this EIS/OEIS to accurately quantify test activities necessary to meet requirements of DoD Directive 5000.1. These testing requirements are designed to determine whether systems perform as expected and are operationally effective, suitable, survivable, and safe for their intended use. Any reduction of testing activities would not allow the Navy to meet its purpose and need to achieve requirements set forth in DoD Directive 5000.1.

5.3.4.1.2 Replacing Training and Testing with Simulated Activities

Replacing training and testing activities with simulated activities for the purpose of mitigation would result in an unacceptable impact on readiness for the following reasons:

As described in Section 2.5.1.3 (Simulated Training and Testing), the Navy currently uses computer simulation for training and testing whenever possible. Computer simulation can provide familiarity and complement live training; however, it cannot provide the fidelity and level of training necessary to prepare naval forces for deployment. The Navy is required by law to operationally test major platforms, systems, and components of these platforms and systems in realistic combat conditions before full-scale production can occur. Substituting simulation for live training and testing fails to meet the purpose of and need for the Proposed Action and therefore was eliminated from consideration as a mitigation measure.

5.3.4.1.3 Reducing Sonar Source Levels and Total Number of Hours

Active sonar is only used when required by the mission since it has the potential to alert opposing forces to the sonar platform’s presence. Passive sonar and all other sensors are used in concert with active sonar to the maximum extent practicable when available and when required by the mission. Reducing active sonar source levels and the total number of active sonar hours used during training and testing activities for the purpose of mitigation would adversely impact the effectiveness of military readiness activities and increase safety risks to personnel for the following reasons:

Sonar operators need to train as they would operate during real world combat situations. Operators of sonar equipment are always cognizant of the environmental variables affecting sound propagation. In this regard, sonar equipment power levels are always set consistently with mission requirements. Reducing sonar source levels for the purpose of mitigation precludes sonar operators from learning to operate the sonar systems with their entire range of capabilities throughout the extremely diverse range of environmental conditions they may encounter. Failure to train with the entire range of capabilities will reduce the effectiveness of the sonar operators, should their skills be required during real world events. Sonar operators would not develop the skills necessary to identify and track submarines at the maximum distances of their systems’ capabilities. They would also not learn how to use their systems’ capabilities during the entire range of environmental conditions they may encounter. Likewise, they would not learn how to fully integrate multiple anti-submarine warfare capabilities, including other ships and aircraft into an integrated anti-submarine warfare team.

Failure to train with the entire range of capabilities also compromises training by reducing the ability for a sonar operator to detect, track, and hold an enemy target, mine, or other object; and by reducing the realism of other training scenarios (e.g., navigation training). Particularly during a strike group exercise, sonar operators need to learn to handle real world combat situations (e.g., the ability to manage sonar operations during periods of mutual interference, which can occur when more than one sonar system is operating simultaneously). Training with reduced sonar source levels would ultimately condition Sailors to expect conditions that they would not experience in a real world combat situation, thereby resulting in an unacceptable increased risk to personnel safety and the strike group's ability to achieve mission success.

The Navy must test its systems in the same way they would be used for military readiness activities. Reducing sonar source levels during testing would impact the ability to determine whether systems are operationally effective, suitable, survivable, and safe. Ultimately, reducing sonar source levels would reduce training and testing realism. Reducing the total number of sonar hours used during training and testing would prevent the Navy from meeting its military readiness qualification standards.

5.3.4.1.4 Implementing Active Sonar Ramp-Up Procedures During Training

Implementing active sonar ramp-up procedures (slowly increasing the sound in the water to necessary levels) in an attempt to clear the range prior to conducting activities for the purpose of mitigation during training activities would result in an unacceptable impact on readiness and would not necessarily be effective at reducing potential impacts on marine species for the following reasons:

Ramp-up procedures would alert opponents to the participants' presence. This would consequently negatively affect the realism of training because the target submarine could detect the searching unit before the searching unit could detect the target submarine, enabling the target submarine to take evasive measures. This is not representative of a real world situation and thereby would impact training realism and effectiveness. Training with reduced realism would alter Sailors' abilities to effectively operate in a real world combat situation, thereby resulting in an unacceptable increased risk to personnel safety and sonar operators' ability to achieve mission success.

Although ramp-up procedures have been used for some testing activities, effectiveness at avoiding or reducing impacts on marine mammals has not been demonstrated. Until evidence suggests that ramp-up procedures are effective means of avoiding or reducing potential impacts on marine mammals, the Navy will not implement this measure for training activities and is also proposing to eliminate its implementation for testing activities as part of the Proposed Action (Section 5.3.4.2.1, Implementing Active Sonar Ramp-Up Procedures During Testing).

5.3.4.1.5 Reducing Vessel Speed

As described in Section 5.1.1 (Vessel Safety), as a standard operating procedure, Navy personnel are required to use extreme caution and operate at a slow, safe speed consistent with mission and safety. These standard operating procedures are designed to allow a vessel to take proper and effective action to avoid a collision with any sighted object or disturbance (which may include a marine mammal), and to stop within a distance appropriate to the prevailing circumstances and conditions.

Additionally, Navy-recommended mitigation includes reducing vessel speed within several mitigation areas that have been well-documented as important habitat for the North Atlantic right whale and West Indian manatee. Refer to Section 5.3.3.1.1.1 (North Atlantic Right Whale Southeast Calving Habitat), Section 5.3.3.1.1.2 (North Atlantic Right Whale Northeast Foraging Habitat), and Section 5.3.3.1.2.1

(Manatee Habitat near Mayport, Florida) for additional discussion on these speed restriction mitigation measures. Otherwise implementing widespread reductions in vessel speed throughout the Study Area for the purpose of mitigation would be impractical with regard to implementation of military readiness activities, and result in an unacceptable impact on readiness for several reasons. Vessel operators need to be able to react to changing tactical situations and evaluate system capabilities in training and testing as they would in actual combat. Widespread speed restrictions would not allow the Navy to properly test vessel capabilities (e.g., full power propulsion testing during sea trials). Training with reduced realism would alter Sailors' abilities to effectively operate in a real world combat situation, thereby resulting in an unacceptable increased risk to personnel safety and the vessel operators' ability to achieve mission success.

5.3.4.1.6 Limiting Access to Training and Testing Locations

Limiting training and testing activities to specific locations for the purpose of mitigation would be impractical with regard to implementation, would adversely impact the effectiveness of military readiness activities, and would increase safety risks to personnel for the following reasons:

As described in Section 2.5.1.1 (Alternative Training and Testing Locations), the ability to use the diverse and multidimensional capabilities of each range complex and testing range results in the Navy's ability to develop and maintain high levels of readiness. Major exercises using integrated warfare components require large areas of the littorals, open ocean, and certain nearshore areas for realistic and safe training. Limiting training and testing (including the use of sonar and other active acoustic sources or explosives) to specific locations (e.g., abyssal waters and surveyed offshore waters) and avoiding areas (e.g., embayments or large areas of the littorals and open ocean such as waters west of the Florida Keys and Dry Tortugas) would be impractical to implement with regard to the need to conduct activities in proximity to certain facilities, range complexes, and testing ranges. The Navy typically conducts activities in proximity to certain facilities, range complexes, and testing ranges in order to reduce travel time and funding required to conduct training away from a unit's home base. Activities involving the use of helicopters typically occur in proximity to shore or refueling stations due to fuel restrictions and personnel safety. Training and testing location limitations would also adversely impact the safety of the training and testing activities by requiring activities to take place in more remote areas where safety support may be limited.

Training and testing activities require continuous access to large areas consisting potentially of thousands of square miles of ocean and air space to provide naval personnel the ability to train with and develop competence and confidence in their capabilities and their entire suite of weapons and sensors. Exercises may change mid-stream based on evaluators' assessments of performance and other conditions including weather or mechanical issues. These may preclude use of a permission scheme for access to water space. Threats to national security are constantly evolving and the Navy requires the ability to adapt training to meet these emerging threats as well as develop and test systems to effectively operate by sharpening knowledge of how to operate in these environments. Restricting access to limited locations would impact the ability for Navy training and testing to evolve as the threat evolves.

Operational units already incorporate requirements for safety of personnel, including air space and shipping routes. Safety restrictions may include limits on distance from military air fields during carrier flight operations and air traffic corridors for safety of military and civilian aviation. These types of limitations shape how exercise planners develop and implement training scenarios, including those involving defense of aircraft carriers from submarines.

Therefore, limiting access to training and testing locations would reduce realism of training by restricting access to important real world combat situations, such as bathymetric features and varying oceanographic features. As described in Section 5.3.4.1.7 (Avoiding Locations Based on Bathymetry and Environmental Conditions), Sailors must be trained to handle bottom bounce, sound passing through changing currents, eddies, or across changes in ocean temperature, pressure, or salinity. Training in a few specific locations would alter Sailors' abilities to effectively operate in varying real world combat situations, thereby resulting in an unacceptable increased risk to personnel safety and the ability to achieve mission success.

5.3.4.1.7 Avoiding Locations Based on Bathymetry and Environmental Conditions

As discussed in Section 5.3.3.1.3.1 (Planning Awareness Areas), the Navy has designated several planning awareness areas based on areas of high productivity that have been correlated with high concentrations of marine mammals (e.g., persistent oceanographic features like upwellings associated with the Gulf Stream front where it is deflected off the east coast near the Outer Banks), and areas of steep bathymetric contours that are frequented by deep-diving marine mammals such as beaked whales and sperm whales. For reference, the planning awareness areas encompass the Mississippi Canyon and a portion of the DeSoto Canyon.

For events involving active sonar, the Navy will avoid planning major exercises in the planning awareness areas where feasible. Otherwise avoiding locations for training and testing activities based on bathymetry and environmental conditions for the purpose of mitigation would result in unacceptable impacts on readiness and increased risk to personnel safety for the following reasons:

Areas where training and testing activities are scheduled to occur are carefully chosen to provide safety and allow realism of events. As described in Section 2.5.1.1 (Alternative Training and Testing Locations), the varying environmental conditions of the Study Area (e.g., bathymetry and topography) maximize the training realism and testing effectiveness. Limiting training and testing, including the use of sonar and other active acoustic sources or explosives, to avoid steep or complex bathymetric features (e.g., submarine canyons and large seamounts) and oceanographic features (e.g., surface fronts and variations in sea surface temperatures) would reduce the realism of the military readiness activity. Systems must be tested in a variety of bathymetric and environmental conditions to ensure functionality and accuracy in a variety of environments. Sonar operators need to train as they would operate during real world combat situations. Because real world combat situations include diverse bathymetric and environmental conditions, Sailors must be trained to handle bottom bounce, sound passing through changing currents, eddies, or across changes in ocean temperature, pressure, or salinity. Training with reduced realism would alter Sailors' abilities to effectively operate in a real world combat situation, thereby resulting in an unacceptable increased risk to personnel safety and the sonar operators' ability to achieve mission success.

5.3.4.1.8 Avoiding or Reducing Active Sonar at Night and During Periods of Low Visibility

Avoiding or reducing active sonar at night and during periods of low visibility for the purpose of mitigation would result in an unacceptable impact on readiness for the following reasons:

The Navy must train in the same manner as it will fight. Anti-submarine warfare can require a significant amount of time 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). Reducing or securing power in low-visibility conditions would affect a commander's ability to develop this tactical picture and would not provide the needed training realism. Training differently from what would be needed in an actual combat scenario would decrease training effectiveness, reduce crews' abilities, and introduce an increased safety risk to personnel.

Mid-frequency active sonar training is required year-round in all environments, including night and low-visibility conditions. Training occurs over many hours or days, which requires large teams of personnel working together in shifts around the clock to work through a scenario. Training at night is vital because environmental differences between day and night affect 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, which affects sound propagation and could affect how sonar systems are operated. Consequently, personnel must train during all hours of the day to ensure they identify and respond to changing environmental conditions, and not doing so would unacceptably decrease training effectiveness and reduce the crews' abilities. Therefore, the Navy cannot operate only in daylight hours or wait for the weather to clear before training.

The Navy must test its systems in the same way they would be used for military readiness activities. Reducing or securing power in adverse weather conditions or at night would impact the ability to determine whether systems are operationally effective, suitable, survivable, and safe. Additionally, some systems have a nighttime testing requirement. Therefore, Navy personnel cannot operate only in daylight hours or wait for the weather to clear before or during all test events.

5.3.4.1.9 Avoiding or Reducing Active Sonar During Strong Surface Ducts

Avoiding or reducing active sonar during strong surface ducts for the purpose of mitigation wouldincrease safety risks to personnel, be impractical with regard to implementation of military readiness activities, and result in unacceptable impacts on readiness for the following reasons:

The Navy must train in the same manner as it will fight. Anti-submarine warfare can require a significant amount of time 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). Surface ducting is a condition when water conditions (e.g., temperature layers, lack of wave action) result in little sound energy penetrating beyond a narrow layer near the surface of the water. Submarines have long been known to exploit the phenomena associated with surface ducting. Therefore, training in surface ducting conditions is a critical component to 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 in this environment. Avoiding or reducing active sonar during surface ducting conditions would affect a commander's ability to develop this tactical picture and would not provide the needed training realism. Diminished realism would reduce a sonar operator's ability to effectively operate in a real world combat situation, thereby resulting in an unacceptable increased risk to personnel safety and the ability to achieve mission success.

Furthermore, avoiding surface ducting would be impractical to implement 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.

5.3.4.1.10 Avoiding Locations Based on Distances From Isobaths or Shorelines

Avoiding locations for training and testing activities within the AFTT Study Area based on wide-scale distances from isobaths or the shoreline for the purpose of mitigation would be impractical with regard to implementation of military readiness activities, result in unacceptable impact on readiness, would not be an effective means of mitigation, and would increase safety risks to personnel for the following reasons:

A measure requiring avoidance of mid-frequency active sonar within 13 nm of the 656 ft. (200 m) isobaths was part of the Rim of the Pacific exercise 2006 authorization by NMFS. The Rim of the Pacific exercise was outside of the AFTT Study Area. This measure, as well as similar measures of like distances, lacks any scientific basis when applied to the context of the AFTT Study Area (e.g., bathymetry, sound propagation, and width of channels). There is no scientific analysis indicating this measure is protective and no known basis for these specific metrics. The Rim of the Pacific Exercise 2006 mitigation measure precluded active anti-submarine warfare training in the littoral region, which significantly impacted realism and training effectiveness (e.g., protecting ships from submarine threats during amphibious landings). This mitigation procedure had no observable impact on the protection of marine mammals during Rim of the Pacific Exercise 2006, and its value is unclear; however, its adverse impact on realistic training, as with all arbitrary distance-from-land restrictions, is significant.

Training in shallow water is an essential component to maintaining military readiness. Sound propagates differently in shallow water and operators must learn to train in this environment. Additionally, submarines have become quieter through the use of improved technology and have learned to hide in the higher ambient noise levels of the shallow waters of coastal environments. In real world events, it is highly likely that Sailors would be working in, and therefore must train in, these types of areas.

Areas where training and testing activities are scheduled to occur are carefully chosen to provide safety and allow realism of events. The proximity to facilities, range complexes, and testing ranges is essential to the training and testing realism and effectiveness required to train and certify naval forces ready for combat operations. Limiting access to nearshore areas would restrict access to certain training and testing locations and would increase transit time for these activities, which would result in an increased risk to personnel safety, particularly for platforms with fuel restrictions (e.g., aircraft) or for certain activities such as mine countermeasures and neutralization activities using diver-placed mines.

The ability to use the diverse and multi-dimensional capabilities of each range complex and testing range results in the Navy's ability to develop and maintain high levels of readiness. Otherwise limiting training and testing (including the use of sonar and other active acoustic sources or explosives) to avoid arbitrary distances from isobaths or the shoreline would adversely impact the effectiveness of the training and testing. This includes avoiding conducting activities within 12 nm from shore, 25 nm from shore, between shore and the 20 m isobath, and 13 nm out from the 656 ft. (250 m) isobath. Operating in shallow water is essential in order to provide realistic training during real world combat conditions with regard to shallow water sound propagation.

5.3.4.1.11 Avoiding Marine Species Habitats

The Navy has recommended measures within several mitigation areas (Section 5.3.3, Mitigation Areas) that have been well-documented as important habitats for particular species and in which implementation of mitigation would not result in unacceptable impacts on readiness. These mitigation areas have been carefully selected on a case-by-case basis through consultation with NMFS and the U.S. Fish and Wildlife Service. Otherwise avoiding all marine species habitats (e.g., foraging locations, reproductive locations, migration corridors, and locations of modeled takes) for the purpose of mitigation would be impractical with regard to implementation of military readiness activities, would result in unacceptable impacts on readiness, and would increase safety risks to personnel for the following reasons:

As described in Section 5.3.4.1.6 (Limiting Access to Training and Testing Locations) and Section 5.3.4.1.7 (Avoiding Locations Based on Bathymetry and Environmental Conditions), areas where training and testing activities are scheduled to occur are carefully chosen to provide safety and allow realism of events, and the varying environmental conditions of these areas maximize the training realism and testing effectiveness. Activity locations inevitably overlap a wide array of marine species habitats, including foraging habitats, reproductive areas, and migration corridors. Otherwise limiting activities to avoid these habitats would adversely impact the effectiveness of the training or testing activity, and would therefore result in an unacceptable increased risk to personnel safety and the ability to achieve mission success.

As described in the *Determination of Acoustic Effects on Marine Mammals and Sea Turtles for the Atlantic Fleet Training and Testing Environmental Impact Statement/Overseas Environmental Impact Statement* technical report (Marine Species Modeling Team 2013), modeling locations were developed based on historical data and anticipated future needs. The model does not provide information detailed enough to analyze or compare locations based on potential take levels for each activity; therefore applying the modeling results to inform development of mitigation areas would not be appropriate.

5.3.4.1.12 Avoiding Marine Protected Areas

This section discusses marine protected areas (excluding national marine sanctuaries). Refer to Section 5.3.4.2.8 (Limiting Active Sonar Activities within National Marine Sanctuaries) for a discussion specific to national marine sanctuaries.

The Navy has recommended measures within several mitigation areas (Section 5.3.3, Mitigation Areas) that have been well-documented as important habitats for particular species and in which implementation of mitigation would not result in unacceptable impacts on readiness. These mitigation areas have been carefully selected on a case-by-case basis through consultation with NMFS and the U.S. Fish and Wildlife Service. Otherwise avoiding all marine protected areas for the purpose of mitigation would result in an unacceptable impacts on readiness; increase safety risks to personnel; be impractical with regard to implementation; and would not be warranted based on the Chapter 3 (Affected Environment and Environmental Consequences) environmental analyses for biological resources, Section 6.1.2 (Marine Protected Areas) discussions, and the discussions below. Furthermore, the mitigation measures outlined in Section 5.3.1 (Lookout Procedural Measures) and Section 5.3.2 (Mitigation Zone Procedural Measures) have been developed to reduce potential impacts on marine species regardless of activity location.

As described in Section 6.1.2 (Marine Protected Areas), due to the nature of most training and testing activities (e.g., requiring deep water), proposed activities are unlikely to occur in the extremely shallow nearshore waters typical of most marine protected areas. Within most marine protected areas, the only activity likely to occur is an aircraft overflight during transit from an airfield to an offshore training or testing location. Exposure of marine protected area resources to aircraft overflights would be brief and is expected to cause only a minor and temporary behavioral reaction due to noise for marine mammals, sea turtles, birds, or fish that may be present in the area. There is potential for birds to be struck by aircraft; however, the Navy implements standard operating procedures that require pilots of Navy aircraft to make every attempt to avoid large flocks of birds in order to reduce the safety risk involved with a potential bird strike. Additional mitigation or avoidance of these marine protected areas would be unnecessary, and limiting passage through the areas would restrict direct access to training and testing locations. Such avoidance would ultimately increase transit time and for platforms with fuel restrictions (e.g., aircraft) would therefore result in an unacceptable increased risk to personnel safety.

For marine protected areas (e.g., gear restricted areas) located further offshore, activities in addition to aircraft overflights may occur. Refer to Section 6.1.2 (Marine Protected Areas) for a more detailed discussion on the activities that are expected to occur within marine protected areas in the Study Area. Ultimately, limiting access to training and testing locations that overlap, are contained within, or are adjacent to marine protected areas would reduce realism of training by restricting access to important real world combat situations, such as bathymetric features and varying oceanographic features. As described in Section 2.5.1.1 (Alternative Training and Testing Locations), the ability to use the diverse and multidimensional capabilities of each range complex and testing range results in the Navy's ability to develop and maintain high levels of readiness. Major exercises using integrated warfare components require large areas of the littorals, open ocean, and certain nearshore areas for realistic and safe training. Limiting training and testing to specific locations and avoiding all marine protected areas would be impractical to implement with regard to the need to conduct activities in proximity to certain facilities, range complexes, and testing ranges. The Navy typically conducts activities in proximity to certain facilities, range complexes, and testing ranges in order to reduce travel time and funding required to conduct training away from a unit's home base. Activities involving the use of helicopters typically occur in proximity to shore or refueling stations due to fuel restrictions and personnel safety. Training and testing location limitations would also adversely impact the safety of the training and testing activities by requiring activities to take place in more remote areas where safety support may be limited. Refer to Section 5.3.4.1.6 (Limiting Access to Training and Testing Locations) for further discussion on the impacts of limiting access to training and testing locations on the Navy's ability to maintain military readiness.

5.3.4.1.13 Increasing Visual and Passive Acoustic Observations

Increasing visual and passive acoustic observations for the purpose of mitigation would be impractical with regard to implementation of military readiness activities and result in unacceptable impacts on readiness for the following reasons:

The Navy-recommended mitigation measures already represent the maximum level of effort (e.g., numbers of Lookouts and passive sonobuoys) that the Navy can commit to observe mitigation zones given the number of personnel that will be involved and the number and type of assets and resources available. The number of Lookouts that the Navy recommends for each measure often represents the maximum capacity based on limited resources (e.g., space and manning restrictions). For example, platforms such as the Littoral Combat Ship are minimally manned and are therefore physically unable to accommodate more than one Lookout. Furthermore, training and testing activities are carefully planned with regard to personnel duties. Requiring additional Lookouts would either require adding personnel, for which there would be no additional space, or reassigning duties, which would divert Navy personnel from essential tasks required to meet mission objectives.

The Navy will conduct passive acoustic monitoring during several activities with Navy assets, such as sonobuoys, already participating in the activity (e.g., sinking exercises, torpedo [explosive] testing, and Improved Extended Echo Ranging sonobuoys). Refer to Section 5.3.2 (Mitigation Zone Procedural Measures) for additional information on the use of passive acoustics during training and testing activities. The Navy does not have the resources to construct and maintain additional passive acoustic monitoring systems for each training and testing activity.

5.3.4.1.14 Increasing the Size of Observed Mitigation Zones

Increasing the size of observed mitigation zones for the purpose of mitigation would be impractical with regard to implementation of military readiness activities and result in unacceptable impact on readiness for the following reasons:

The Navy developed activity-specific mitigation zones based on the Navy's acoustic propagation model. In this AFTT analysis, the Navy developed each recommended mitigation zone to avoid or reduce the potential for onset of the lowest level of injury, PTS, out to the predicted maximum range. Mitigating to the predicted maximum range to PTS consequently also mitigates to the predicted maximum range to onset mortality (1 percent mortality), onset slight lung injury, and onset slight gastrointestinal tract injury, since the maximum range to effects for these criteria are shorter than for PTS. Furthermore, in most cases, the predicted maximum range to PTS also covers the predicted average range to TTS. In some instances, the Navy recommends mitigation zones that are larger or smaller than the predicted maximum range to PTS based on the associated effectiveness and operational assessments presented in Section 5.3.2 (Mitigation Zone Procedural Measures).

The Navy-recommended mitigation zones represent the maximum area the Navy can effectively observe based on the platform of observation, number of personnel that will be involved, and the number and type of assets and resources available. As mitigation zone sizes increase, the potential for reducing impacts decreases. For instance, if a mitigation zone increases from 1,000 to 4,000 yd. (914 to 3,658 m), the area that must be observed increases sixteen-fold. The Navy-recommended mitigation measures balance the need to reduce potential impacts with the ability to provide effective observations throughout a given mitigation zone. Implementation of mitigation zones is most effective when the zone is appropriately sized to be realistically observed. The Navy does not have the resources to maintain additional Lookouts or observer platforms that would be needed to effectively observe mitigation zones of increased size. Further, as explained above, the number of Lookouts that the Navy recommends for each measure often represents the maximum capacity based on limited resources (e.g., space and manning restrictions). For example, platforms such as the Littoral Combat Ship are minimally manned and are therefore physically unable to accommodate more than one Lookout. Training and testing activities are carefully planned with regard to personnel duties. Requiring observation of mitigation zones of increased size would either require adding personnel, for which there would be no additional space or resources, or reassigning duties, which would divert Navy personnel from essential tasks required to meet mission objectives. For most activities, Lookouts are required to observe for concentrations of detached floating vegetation (*Sargassum* or kelp paddies), which are indicators of potential marine mammal and sea turtle presence, within the mitigation zone to further help reduce the potential for injury to occur.

5.3.4.1.15 Conducting Visual Observations Using Third-Party Observers

With limited exceptions, use of third-party observers (e.g., trained marine species observers) in air or on surface platforms in addition to existing Navy Lookouts for the purposes of mitigation would be impractical with regard to implementation of military readiness activities and result in unacceptable impacts on readiness for the following reasons:

Navy personnel are extensively trained in spotting items on or near the water surface. Use of Navy Lookouts ensures immediate implementation of mitigation if marine species are sighted. A critical skill set of effective Navy training is communication. Navy Lookouts are trained to act swiftly and decisively to ensure that appropriate actions are taken. Additionally, multiple training and testing events can occur simultaneously and in various regions throughout the Study Area, and can last for days or weeks at a time. The Navy does not have the resources to maintain third-party observers to accomplish the task for every event.

The use of third-party observers would compromise security for some activities involving active sonar due to the requirement to provide advance notification of specific times and locations of Navy platforms. Reliance on the availability of third-party personnel would impact training and testing flexibility. The presence of other aircraft in the vicinity of naval activities would raise safety concerns for both the commercial observers and naval aircraft. Furthermore, vessels have limited passenger capacity. Training and testing event planning includes careful consideration of this limited capacity in the placement of personnel on vessels involved in the event. Inclusion of non-Navy observers onboard these vessels would require that in some cases there would be no additional space for essential Navy personnel required to meet the exercise objectives.

The areas where training events will most likely occur in the Study Area cover approximately 1 million square nm. Contiguous anti-submarine warfare events may cover many hundreds or even thousands of square miles. The number of civilian vessels or aircraft required to monitor the area of these events would be considerable. It is, thus, not feasible to survey or monitor the large exercise areas in the time required. In addition, marine mammals may move into or out of an area, if surveyed before an event, or an animal could move into an area after an event took place. Given that there are no adequate controls to account for these or other possibilities, there is little utility to performing extensive before or after event surveys of large exercise areas as a mitigation measure.

Surveying during an event raises safety issues with multiple, slow civilian aircraft operating in the same airspace as military aircraft engaged in combat training activities. In addition, many of the training and testing events take place far from land, limiting both the time available for civilian aircraft to be in the event area and presenting a concern should aircraft mechanical problems arise. Scheduling civilian vessels or aircraft to coincide with training events would impact training effectiveness, since exercise event timetables cannot be precisely fixed and are instead based on the free-flow development of tactical situations. Waiting for civilian aircraft or vessels to complete surveys, refuel, or be on station would slow the progress of the exercise and impact the effectiveness of the military readiness activity.

5.3.4.1.16 Adopting Mitigation Measures of Foreign Navies

Adopting mitigation measures of foreign navies generally for the purpose of mitigation, such as expanding the mitigation zones to match those used by a particular foreign navy, would be impractical with regard to implementation of military readiness activities and result in unacceptable impacts on readiness for the following reasons:

Mitigation measures are carefully customized for and agreed upon by each individual navy based on potential impacts of the activities on marine species and the impacts of the mitigation measures on military readiness. The mitigation measures developed for one navy would not necessarily be effective at reducing potential impacts on marine species by all navies. Similarly, mitigation measures that do not cause an unacceptable impact on one navy may cause an unacceptable impact on another. For example, most other navies do not possess an integrated strike group and do not have integrated training requirements. The Navy’s training is built around the integrated warfare concept and is based on the Navy’s capabilities, the threats faced, the operating environment, and the overall mission. Implementing other navies’ mitigation would be incompatible with U.S. Navy requirements.

Other particular measures used by foreign navies are discussed throughout this section. The U.S. Navy's recommended mitigation measures have been carefully designed to reduce potential impacts on marine species while not causing an unacceptable impact on readiness.

5.3.4.1.17 Increasing Reporting Requirements

The Navy has extensive reporting requirements, including exercise, testing, and monitoring reporting designed to verify implementation of mitigation, comply with current permits, and improve future environmental assessments (Section 5.5.2, Reporting). Increasing the requirement to report marine species sightings to augment scientific data collection and to further verify the implementation of mitigation measures is unnecessary and would increase safety risks to personnel, be impractical with regard to implementation of military readiness activities, and result in unacceptable impacts on readiness for the following reasons:

Vessels, aircraft, and personnel engaged in training and testing events are intensively employed throughout the duration of training and testing activities. Any additional workload assigned that is unrelated to their primary duty would adversely impact personnel safety and the effectiveness of the military readiness activity they are undertaking. Lookouts are not trained to make accurate species-specific identification and would not be able to provide the detailed information that the scientific community would use. Alternatively, the Navy has an integrated comprehensive monitoring program (Section 5.5, Monitoring and Reporting) that does provide information that is available and useful to the scientific community in annual monitoring reports.

5.3.4.2 Previously Accepted but Now Eliminated

5.3.4.2.1 Implementing Active Sonar Ramp-Up Procedures During Testing

Some testing activities have implemented active sonar ramp-up procedures (slowly increasing the sound in the water to necessary levels) in an attempt to clear the range prior to conducting activities for the purpose of mitigation. Although ramp-up procedures have been used for some testing activities, the effectiveness at avoiding or reducing impacts on marine mammals has not been demonstrated. Until evidence suggests that ramp-up procedures are an effective means of avoiding or reducing potential impacts on marine mammals, and for reasons discussed in Section 5.3.4.1.4 (Implementing Active Sonar Ramp-Up Procedures During Training), the Navy is proposing to eliminate the implementation of this measure for testing activities as part of the Proposed Action.

5.3.4.2.2 Implementing a Mitigation Zone for Missile Exercises with Airborne Targets

Per current mitigation, a mitigation zone of 1,000 yd. (915 m) is observed around the expected expended material field. The Navy is proposing to eliminate the need for a Lookout to maintain a mitigation zone for missile exercises involving airborne targets. Most airborne targets are recoverable aerial drones, and missile impact with the target does not typically occur. Most anti-air missiles used in training are telemetry configured (i.e., they do not have an actual warhead). Impact of a target is unlikely because missiles are designed to detonate (simulated detonation for telemetry missiles) in the vicinity of the target and not as a result of a direct strike on the target. Given the speed of the missile and the target, the high altitudes involved, and the long ranges of missile travel possible, 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 in excess of 80 nm from the firing location, and thousands of yards for shorter events, which can occur within several thousand yards from the firing location. Establishment of a mitigation zone for activities involving airborne targets would be ineffective at reducing potential impacts.

Furthermore, the potential risk to any marine mammal or sea turtle from a missile exercise with an airborne target is a direct strike from falling military expended materials. Based on the extremely low potential for a target strike and associated expended material field to co-occur in space and time with a marine species at or near the surface of the water, the potential for a direct strike is negligible.

5.3.4.2.3 Implementing a Mitigation Zone for Medium- and Large-Caliber Gunnery Exercises with Airborne Targets

Per current mitigation, a mitigation zone is observed in the vicinity of the expected military expended materials field. The Navy is proposing to eliminate the need for a Lookout to observe the vicinity of the expected military expended materials for medium- and large-caliber gunnery exercises involving airborne targets. The potential military expended materials fall zone can only be predicted within thousands of yards, which can be up to 7 nm from the firing location. Establishment of a mitigation zone for activities involving airborne targets would be ineffective at reducing potential impacts.

Furthermore, the potential risk to any marine mammal or sea turtle from a gunnery exercise with an airborne target is a direct strike from falling military expended materials. Based on the extremely low potential for military expended materials to co-occur in space and time with a marine species at or near the surface of the water, the potential for a direct strike is negligible.

5.3.4.2.4 Implementing Measures for Laser Test Operations

Per current mitigation, within the Naval Surface Warfare Center, Panama City Division Testing Range, visual surveys would be conducted for all testing activities involving laser line scan, light imaging detection and ranging lasers. Per current standard operating procedures, only trained personnel operate lasers and visual observation of the area is conducted to ensure human safety. The Navy is proposing to discontinue this procedure as a mitigation measure because (1) it is currently a standard operating procedure conducted for human safety, and (2) the environmental consequences analysis suggests that impacts on resources from laser activities are not expected.

5.3.4.2.5 Implementing an Additional Mitigation Zone for Non-Explosive Bombing Exercises in the North Atlantic Right Whale Southeast Mitigation Area

Per current mitigation, the Navy does not release non-explosive bombs within 2 nm of a North Atlantic right whale during the non-calving season from 16 April to 14 November. The Navy recommends discontinuing this measure, and implementing (year-round) the recommended 1,000-yd. (914-m) mitigation zone for non-explosive bombing exercises described in Section 5.3.2 (Mitigation Zone Procedural Measures) for all marine mammal and sea turtle species observed. Since the potential risk to any marine mammal or sea turtle from a non-explosive bomb is a direct strike, a 1,000 yd. mitigation zone is sufficient to reduce this risk. Furthermore, Lookouts are not trained to make accurate species-specific identification and implementing the current mitigation measure just for North Atlantic right whales is impractical.

5.3.4.2.6 Conducting Explosive Large-Caliber Gunnery Exercises Using the Integrated Maritime Portable Acoustic Scoring System in Specified Training Areas

Per current mitigation within the JAX Range Complex, the Navy currently only conducts explosive large-caliber gunnery exercises using the integrated maritime portable acoustic scoring system in training areas BB and CC during the North Atlantic right whale non-calving season (16 April to 14 November), and in the deep water training area year-round. The Navy recommends discontinuing these measures to not confine this activity within these training areas due to the unacceptable impact these measures have on readiness. Additional training areas are necessary because (1) the BB and CC ranges are often fouled from commercial and recreational vessels, and (2) training area CC experiences high surface currents, which are incompatible with the scoring system's buoys. The mitigation zone will be applied regardless of the location of the activity. Per other current mitigation, the Navy will continue to not conduct this activity within the North Atlantic right whale southeast calving habitat mitigation area.

5.3.4.2.7 Limiting Electromagnetic Testing Operations During Sea Turtle Nesting Season

Per current mitigation within the Naval Surface Warfare Center, Panama City Division Testing Range, when operationally feasible, the Navy does not conduct electromagnetic activities and tests within 33 yd. (30 m) of shore during sea turtle nesting and hatching season between May 1 and September 30. The Navy is proposing to discontinue this measure because the environmental consequences analysis suggests that impacts on sea turtles from electromagnetic activities are not expected. Therefore, this mitigation measure is not necessary to reduce potential impacts.

5.3.4.2.8 Limiting Active Sonar Activities in National Marine Sanctuaries

Per current mitigation, the Navy had voluntarily restricted active sonar within (including a 2.7 nm buffer around) Gerry E. Studds Stellwagen Bank, Gray's Reef, *Monitor*, Florida Keys, and Flower Garden Banks National Marine Sanctuaries. The Navy is proposing to discontinue this restriction because (1) as discussed in Section 6.1.2.5.1 (Gerry E. Studds Stellwagen Bank National Marine Sanctuary), the Navy does not plan to use active sonar within (including a 2.7 nm buffer around) Gerry E. Studds Stellwagen Bank National Marine Sanctuary as part of its Proposed Action, and (2) avoiding active sonar activities within Gray's Reef, *Monitor*, Florida Keys, and Flower Garden Banks National Marine Sanctuaries is not warranted based on the discussions presented in the Chapter 3 (Affected Environment and Environmental Consequences) environmental analyses for biological resources. Additionally, the Navy has operated under a worldwide set of mitigation measures for over 7 years, and has been providing monitoring and activity reports annually for nearly 5 years. The information gained during the past 7 years has supplemented the Navy's knowledge and understanding regarding the limited impacts of active sonar on protected species and other resources.

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 fish that may be present in the area. No effect is anticipated to corals or the *Monitor* shipwreck. There is potential for marine mammals and sea turtles to be injured (PTS) from sonar and other active acoustic sources. Although marine mammals and sea turtles may occur within Gray's Reef and Flower Garden Banks National Marine Sanctuaries, there is no evidence to suggest that these species would be concentrated in these areas; therefore the likelihood of injury is low. Within (including a 2.7 nm buffer around) the Florida Keys National Marine Sanctuary, sonar and other active acoustic sources that have the highest potential to result in injury to marine mammals (e.g., bin MF1) would not be conducted as part of the Proposed Action. For a more detailed discussion of potential impacts on these resources from the use of sonar and other active acoustic sources, see the following sections:

- Section 3.4.3.1.8 (Impacts from Sonar and Other Active Acoustic Sources) for marine mammals
- Section 3.5.3.1.7 (Impacts from Sonar and Other Active Acoustic Sources) for sea turtles
- Section 3.6.3.1.1 (Impacts from Sonar and Other Active Acoustic Sources) for birds
- Section 3.8.3.1.1 (Impacts from Sonar and Other Non-Impulsive Acoustic Sources) for invertebrates
- Section 3.9.3.1.2 (Impacts from Sonar and Other Non-Impulsive Acoustic Sources) for fish

Although the Navy recommends discontinuing the mitigation specific to national marine sanctuaries, the Navy will continue implementing mitigation measures to reduce the potential for marine mammals and sea turtles to be exposed to sonar and other active acoustic sources throughout the entire AFTT Study Area wherever and whenever active sonar activities are conducted (Section 5.3.1.2.1, Acoustic Stressors – Non-Impulsive Sound, and Section 5.3.2.1.1, Non-Impulsive Sound).

5.4 MITIGATION SUMMARY

Table 5.4-1 provides a summary of the Navy's recommended mitigation measures. For reference, currently implemented mitigation measures for each activity category are also summarized in the table. The process for developing each of these measures is detailed in Section 5.2.3 (Assessment Method) and involved (1) an effectiveness assessment to determine if implementation of the measure will likely result in avoidance or reduction of an impact on a resource, and (2) an operational assessment to determine if implementation of the measures will have acceptable operational impacts on the Proposed Action with regard to personnel safety, practicality of implementation, readiness, and Navy policy. Measures are intended to meet applicable regulatory compliance requirements for NEPA, Executive Order 12114, and Council on Environmental Quality guidance. The Navy-recommended mitigation measures were also developed consistent with resource-specific environmental requirements, as follows:

- Measures specifying marine mammals and indicators of marine mammal presence (e.g., floating vegetation [*Sargassum* or kelp paddies], large schools of fish, or flocks of seabirds) as the protection focus are intended to meet MMPA requirements.
- Measures specifying marine mammals, sea turtles, flocks of seabirds, piping plovers, floating vegetation (*Sargassum* or kelp paddies), large schools of fish, jellyfish aggregations, or shallow coral reefs as the protection focus are intended to meet ESA requirements.
- Measures specifying shallow coral reefs, live hard bottom, or artificial reefs as the protection focus are intended to meet Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act.
- Measures specifying shipwrecks as the protection focus are intended to meet Abandoned Shipwreck Act and National Historic Preservation Act requirements.

The measures presented in Table 5.4-1 are discussed in greater detail in Section 5.3.1 (Lookout Procedural Measures), Section 5.3.2 (Mitigation Zone Procedural Measures), and Section 5.3.3 (Mitigation Areas). As discussed in Section 5.2.2.2 (Protective Measures Assessment Protocol), the final suite of mitigations resulting from the ongoing planning for this Final EIS/OEIS, as well as the regulatory consultation and permitting processes will be integrated into the Protective Measures Assessment Protocol for implementation purposes. Section 5.5 (Monitoring and Reporting) describes the monitoring and reporting efforts the Navy will undertake to investigate the effectiveness of implemented mitigation measures and to better understand the impacts of the Proposed Action on marine resources.

Table 5.4-1: Summary of Recommended Mitigation Measures

Activity Category or Mitigation Area	Recommended Lookout Procedural Measure	Recommended Mitigation Zone and Protection Focus	Current Measure and Protection Focus
Specialized Training	Lookouts will complete the Introduction to the U.S. Navy Afloat Environmental Compliance Training Series and the U.S. Navy Marine Species Awareness Training or civilian equivalent.	The mitigation zones observed by Lookouts are specified for each Mitigation Zone Procedural Measure below.	The mitigation zones observed by Lookouts are specified for each Mitigation Zone Procedural Measure below.
Low-Frequency and Hull-Mounted Mid-Frequency Active Sonar during Anti-Submarine Warfare and Mine Warfare	2 Lookouts (general) 1 Lookout (minimally manned, moored, or anchored)	Sources that can be powered down: 1,000 yd. (914 m) and 500 yd. (457 m) power downs and 200 yd. (183 m) shutdown for marine mammals (hull-mounted mid-frequency and low-frequency) and sea turtles (low-frequency only). Sources that cannot be powered down: 200 yd. (183 m) shutdown for marine mammals and sea turtles. Both: observation for concentrations of floating vegetation (*Sargassum* or kelp paddies).	Hull-mounted mid-frequency: 1,000 yd. (914 m) and 500 yd. (457 m) power downs and 200 yd. (183 m) shutdown for marine mammals and sea turtles; avoidance of *Sargassum* rafts. Low-frequency: None
High-Frequency and Non-Hull Mounted Mid-Frequency Active Sonar	1 Lookout	200 yd. (183 m) for marine mammals (high-frequency and mid-frequency), sea turtles (bins MF8, MF9, MF10, and MF12 only), and concentrations of floating vegetation (*Sargassum* or kelp paddies).	Non-hull mounted mid-frequency: 200 yd. (183 m) for marine mammals, floating vegetation, and kelp paddies. High-frequency: None
Improved Extended Echo Ranging Sonobuoys	1 Lookout	600 yd. (549 m) for marine mammals, sea turtles, and concentrations of floating vegetation (*Sargassum* or kelp paddies). Passive acoustic monitoring conducted with Navy assets participating in the activity.	1,000 yd. (914 m) for marine mammals and sea turtles; 400 yd. (366 m) for floating vegetation and kelp paddies. Passive acoustic monitoring conducted with Navy assets participating in the activity.
Explosive Sonobuoys Using 0.6–2.5 Pound NEW	1 Lookout	350 yd. (320 m) for marine mammals, sea turtles, and concentrations of floating vegetation (*Sargassum* or kelp paddies). Passive acoustic monitoring conducted with Navy assets participating in the activity.	None
Anti-Swimmer Grenades	1 Lookout	200 yd. (183 m) for marine mammals, sea turtles, and concentrations of floating vegetation (*Sargassum* or kelp paddies).	200 yd. (183 m) for marine mammals, sea turtles, floating vegetation, and kelp paddies.

m: meter; NEW: net explosive weight; yd.: yard;

Table 5.4-1: Summary of Recommended Mitigation Measures (Continued)

Activity Category or Mitigation Area	Recommended Lookout Procedural Measure	Recommended Mitigation Zone and Protection Focus	Current Measure and Protection Focus
Mine Countermeasure and Neutralization Activities Using Positive Control Firing Devices	General: 1 or 2 Lookouts (NEW dependent) Diver-placed: 2 Lookouts Protective Measures Assessment Protocol will contain maps of surveyed shallow coral reefs, artificial reefs, shipwrecks, and live hard bottom.	Both: NEW dependent for marine mammals, sea turtles, and concentrations of floating vegetation (*Sargassum* or kelp paddies). Both: 350 yd. (320 m) from surveyed shallow coral reefs, live hard bottom, artificial reefs, and shipwrecks. Both: 1 nm from beach in the VACAPES Range Complex and 3,000 ft. (914 m) around Fisherman Island for birds. Diver-placed: 3.2 nm from an estuarine inlet and 1.6 nm from shoreline within the Navy Cherry Point Range Complex for sea turtles.	General: NEW dependent for marine mammals and sea turtles. Diver-placed: 700 yd. (640 m) for up to 20 lb. NEW for marine mammals and turtles. Both: 1,000 ft. (305 m) from surveyed live hard bottom, artificial reefs, and shipwrecks. Both: 1 nm from beach and 3,000 ft. (914 m) around Fisherman Island in the VACAPES Range Complex for birds. Diver-placed: 3.2 nm from estuarine inlet and 1.6 nm from shoreline in VACAPES, Navy Cherry Point, and JAX Range Complexes for sea turtles.
Mine Neutralization Activities Using Diver-Placed Time-Delay Firing Devices	4 Lookouts Protective Measures Assessment Protocol will contain maps of surveyed shallow coral reefs, artificial reefs, shipwrecks, and live hard bottom.	Up to 10 min. time-delay using up to 20 lb. NEW: 1,000 yd. (915 m) for marine mammals, sea turtles, and concentrations of floating vegetation (*Sargassum* or kelp paddies). 350 yd. (320 m) for surveyed shallow coral reefs, live hard bottom, artificial reefs, and shipwrecks. 1 nm from beach in the VACAPES Range Complex and 3,000 ft. (914 m) around Fisherman Island for birds. 3.2 nm from an estuarine inlet and 1.6 nm from shoreline within the Navy Cherry Point Range Complex for sea turtles.	10 min. time-day on 20 lb. NEW: 1,450 yd. (1.3 km) for marine mammals and sea turtles.

ft.: feet; JAX: Jacksonville; km: kilometer; lb.: pound; m: meter; min.: minute; NEW: net explosive weight; nm: nautical mile; yd.: yard; VACAPES: Virginia Capes

Table 5.4-1: Summary of Recommended Mitigation Measures (Continued)

Activity Category or Mitigation Area	Recommended Lookout Procedural Measure	Recommended Mitigation Zone and Protection Focus	Current Measure and Protection Focus
Explosive and Non-Explosive Gunnery Exercises – Small- and Medium-Caliber Using a Surface Target	1 Lookout Protective Measures Assessment Protocol will contain maps of surveyed shallow coral reefs.	200 yd. (183 m) for marine mammals, sea turtles, and concentrations of floating vegetation (*Sargassum* or kelp paddies). 350 yd. (320 m) for surveyed shallow coral reefs.	200 yd. (183 m) for marine mammals, sea turtles, floating vegetation, and surveyed shallow coral reefs.
Explosive and Non-Explosive Gunnery Exercises – Large-Caliber Using a Surface Target	1 Lookout Protective Measures Assessment Protocol will contain maps of surveyed shallow coral reefs.	Explosive: 600 yd. (549 m) for marine mammals, sea turtles, and concentrations of floating vegetation (*Sargassum* or kelp paddies). Non-Explosive: 200 yd. (183 m) for marine mammals, sea turtles, and concentrations of floating vegetation (*Sargassum* or kelp paddies). Both: 70 yd. (64 m) within 30 degrees on either side of the gun target line on the firing side for marine mammals, sea turtles, and concentrations of floating vegetation (*Sargassum* or kelp paddies). Both: 350 yd. (320 m) for surveyed shallow coral reefs.	Explosive: 600 yd. (549 m) for marine mammals, sea turtles, floating vegetation, and surveyed shallow coral reefs. Non-Explosive: 200 yd. (183 m) for marine mammals, sea turtles, and concentrations of floating vegetation (*Sargassum* or kelp paddies). Both: 70 yd. (64 m) around entire ship for marine mammals and sea turtles.
Non-Explosive Missile Exercises and Explosive Missile Exercises (Including Rockets) up to 250 Pound NEW Using a Surface Target	1 Lookout Protective Measures Assessment Protocol will contain maps of surveyed shallow coral reefs.	900 yd. (823 m) for marine mammals, sea turtles, and concentrations of floating vegetation (*Sargassum* or kelp paddies). 350 yd. (320 m) for surveyed shallow coral reefs.	1,800 yd. (1.6 km) for marine mammals, sea turtles, floating vegetation, and kelp paddies.
Explosive Missile Exercises Using 251–500 Pound NEW Using a Surface Target	1 Lookout Protective Measures Assessment Protocol will contain maps of surveyed shallow coral reefs.	2,000 yd. (1.8 km) for marine mammals, sea turtles, and concentrations of floating vegetation (*Sargassum* or kelp paddies). 350 yd. (320 m) for surveyed shallow coral reefs.	None

km: kilometer; lb.: pound; m: meter; NEW: net explosive weight; yd.: yard

Table 5.4-1: Summary of Recommended Mitigation Measures (Continued)

Activity Category or Mitigation Area	Recommended Lookout Procedural Measure	Recommended Mitigation Zone and Protection Focus	Current Measure and Protection Focus
Explosive and Non-Explosive Bombing Exercises	1 Lookout Protective Measures Assessment Protocol will contain maps of surveyed shallow coral reefs.	Explosive: 2,500 yd. (2.3 km) for marine mammals, sea turtles, and concentrations of floating vegetation (*Sargassum* or kelp paddies). Non-Explosive: 1,000 yd. (914 m) for marine mammals, sea turtles, and concentrations of floating vegetation (*Sargassum* or kelp paddies). Both: 350 yd. (320 m) for surveyed shallow coral reefs.	Explosive: 5,100 yd. (4.7 km) for marine mammals, sea turtles, and floating vegetation. Non-Explosive: 1,000 yd. (914 m) for marine mammals, sea turtles, floating vegetation, and kelp paddies.
Torpedo (Explosive) Testing	1 Lookout	2,100 yd. (1.9 km) for marine mammals, sea turtles, concentrations of floating vegetation (*Sargassum* or kelp paddies), and jellyfish aggregations. Passive acoustic monitoring conducted with Navy assets participating in the activity.	5,063 yd. (4.6 km) for marine mammals, sea turtles, floating vegetation, and jellyfish aggregations. Passive acoustic monitoring conducted with Navy assets participating in the activity.
Sinking Exercises	2 Lookouts	2.5 nm for marine mammals, sea turtles, concentrations of floating vegetation (*Sargassum* or kelp paddies), and jellyfish aggregations. Passive acoustic monitoring conducted with Navy assets participating in the activity.	4.5 nm for marine mammals and sea turtles. 2.5 nm for floating vegetation and jellyfish aggregations. Passive acoustic monitoring conducted with Navy assets participating in the activity.
At-Sea Explosive Testing	1 Lookout Protective Measures Assessment Protocol will contain maps of surveyed shallow coral reefs.	1,600 yd. (1.4 km) for marine mammals, sea turtles, and concentrations of floating vegetation (*Sargassum* or kelp paddies). 350 yd. (320 m) for surveyed shallow coral reefs.	None
Ordnance Testing – Line Charge Testing	1 Lookout	900 yd. (823 m) for marine mammals, sea turtles, and concentrations of floating vegetation (*Sargassum* or kelp paddies).	880 yd. (805 m) for marine mammals and sea turtles. 0.5 mi. (0.8 km) for Gulf sturgeon.

km: kilometer; lb.: pound; m: meter; mi: mile; nm: nautical mile; yd.: yard

Table 5.4-1: Summary of Recommended Mitigation Measures (Continued)

Activity Category or Mitigation Area	Recommended Lookout Procedural Measure	Recommended Mitigation Zone and Protection Focus	Current Measure and Protection Focus
Ship Shock Trials	At least 10 Lookouts or trained marine species observers (or combination)	10,000-lb. and 40,000-lb. charge: 3.5 nm for all locations for marine mammals, sea turtles, concentrations of floating vegetation (*Sargassum* or kelp paddies), jellyfish aggregations, large schools of fish, and flocks of seabirds.	10,000-lb. charge: 3 nm/3.5 nm for VACAPES / JAX for marine mammals, sea turtles, floating vegetation, jellyfish aggregations, large schools of fish, and flocks of seabirds. 40,000-lb. charge: None.
Elevated Causeway System – Pile Driving	1 Lookout	60 yd. (55 m) for marine mammals, sea turtles, and concentrations of floating vegetation (*Sargassum* or kelp paddies).	None
Vessel Movements	1 Lookout	500 yd. (457 m) for whales. 200 yd. (183 m) for all other marine mammals (except bow riding dolphins).	500 yd. (457 m) for whales. 200 yd. (183 m) for all other marine mammals (except bow riding dolphins).
Towed In-Water Device Use	1 Lookout	250 yd. (229 m) for marine mammals.	250 yd. (229 m) for marine mammals.
Precision Anchoring	No Lookouts in addition to standard personnel standing watch Protective Measures Assessment Protocol will contain maps of surveyed shallow coral reefs, artificial reefs, shipwrecks, and live hard bottom	Avoidance of precision anchoring within the anchor swing diameter of surveyed shallow coral reefs, live hard bottom, artificial reefs, and shipwrecks.	Avoidance of precision anchoring within the anchor watch circle diameter of surveyed shallow coral reefs, live hard bottom, artificial reefs, and shipwrecks.
North Atlantic Right Whale Calving Habitat off the Southeast United States	Activity-specific measures described in the Lookout Procedural Measures and Mitigation Zone Procedural Measures	Avoidance or minimization of conduct of specific activities seasonally. Use Early Warning System sightings data.	Avoidance or minimization of conduct of specific activities seasonally. Use Early Warning System sightings data.

JAX: Jacksonville; km: kilometer; lb.: pound; m: meter; nm: nautical mile; VACAPES: Virginia Capes; yd.: yard

Table 5.4-1: Summary of Recommended Mitigation Measures (Continued)

Activity Category or Mitigation Area	Recommended Lookout Procedural Measure	Recommended Mitigation Zone and Protection Focus	Current Measure and Protection Focus
North Atlantic Right Whale Foraging Habitat off the Northeast	3 Lookouts during torpedo (non-explosive) testing activities All other activity-specific measures described in the Lookout Procedural Measures and Mitigation Zone Procedural Measures	Avoidance or minimization of conduct of specific activities seasonally. Use Sighting Advisory System sightings data. Specific measures for torpedo (non-explosive) testing activities year-round.	Avoidance or minimization of conduct of specific activities seasonally. Use Sighting Advisory System sightings data. Conduct torpedo (non-explosive) testing activities in five designated areas seasonally. Submit written requests prior to conducting hull-mounted surface and submarine active sonar training or helicopter dipping in the mitigation area.
North Atlantic Right Whale Mid-Atlantic Migration Corridor	1 Lookout	Practice increased vigilance, exercise extreme caution, and proceed at the slowest speed that is consistent with safety, mission, and training and testing objectives.	Practice increased vigilance, exercise extreme caution, and proceed at the slowest speed that is consistent with safety, mission, and training and testing objectives.
West Indian Manatee Habitat	Activity-specific measures described in the Lookout Procedural Measures and Mitigation Zone Procedural Measures	Mayport, Florida: Comply with all federal, state, and local Manatee Protection Zones; sightings communication. Port Canaveral, Florida: Pierside sonar observations and sightings communication. Kings Bay, Georgia: Pierside sonar observations and sightings communication. Camp Lejeune, North Carolina: Pile driving observations and sightings log.	Mayport, Florida: Comply with all federal, state, and local Manatee Protection Zones; sightings communication. Port Canaveral, Florida: Pierside sonar observations and sightings communication. Kings Bay, Georgia: Pierside sonar observations and sightings communication. Camp Lejeune, North Carolina: None
Planning Awareness Areas	Activity-specific measures described in the Lookout Procedural Measures and Mitigation Zone Procedural Measures	Limit planning major active sonar exercises.	Limit planning major active sonar exercises.

Table 5.4-1: Summary of Recommended Mitigation Measures (Continued)

Activity Category or Mitigation Area	Recommended Lookout Procedural Measure	Recommended Mitigation Zone and Protection Focus	Current Measure and Protection Focus
Shallow Coral Reefs, Hard Bottom Habitat, Artificial Reefs, and Shipwrecks	No Lookouts in addition to standard personnel standing watch Protective Measures Assessment Protocol will contain maps of surveyed shallow coral reefs, artificial reefs, shipwrecks, and live hard bottom	No precision anchoring within the anchor swing diameter and no explosive mine countermeasure and neutralization activities within 350 yd. (320 m) of surveyed shallow coral reefs, live hard bottom, artificial reefs, and shipwrecks. No explosive or non-explosive small-, medium-, and large-caliber gunnery exercises using a surface target; explosive or non-explosive missile exercises using a surface target; explosive or non-explosive bombing exercises; or at-sea explosive testing within 350 yd. (320 m) of surveyed shallow coral reefs.	Varying mitigation zone distances based on marine mammal ranges to effects.
Live Hard Bottom and Shallow Coral Reefs within South Florida Ocean Measurement Facility	No Lookouts in addition to standard personnel standing watch Protective Measures Assessment Protocol will contain maps of surveyed shallow coral reefs and live hard bottom	Anchors and Mine-like Objects: Installation of anchors and mine-like objects are conducted using real-time GIS and GPS, along with groundtruth and verification support, which will help the Navy avoid sensitive marine species and communities during deployment, installation, and recovery. Bottom Crawling Unmanned Underwater Vehicles: If deployment occurs greater than 9.8 ft. (3 m) in depth, it will be conducted using real-time GIS and GPS, along with groundtruth and verification support, which will help the Navy avoid sensitive marine species and communities.	Anchors and Mine-like Objects: Installation of anchors and mine-like objects are conducted using real-time GIS and GPS, along with groundtruth and verification support, which will help the Navy avoid sensitive marine species and communities during deployment, installation, and recovery. Bottom Crawling Unmanned Underwater Vehicles: None

ft.: feet; GIS: Geographic Information System; GPS: Global Positioning System; m: meter; yd.: yard

Table 5.4-1: Summary of Recommended Mitigation Measures (Continued)

Activity Category or Mitigation Area	Recommended Lookout Procedural Measure	Recommended Mitigation Zone and Protection Focus	Current Measure and Protection Focus
Sea Turtle Nesting Habitat	Activity-specific measures described in the Lookout Procedural Measures and Mitigation Zone Procedural Measures	Naval Surface Warfare Center, Panama City Division: Sea turtle nesting season is defined as from March through September; Avoidance of ordnance testing – line charge testing activities during the night during nesting season. Navy Cherry Point Range Complex: Positive control and time-delay diver-placed mine neutralization and countermeasure activities remain 3.2 nm from estuarine inlets and 1.6 nm from shoreline from March through September.	Naval Surface Warfare Center, Panama City Division: Sea turtle nesting season is defined as from May through September; Avoidance of electromagnetic mine countermeasure and neutralization activities within 32 yd. (30 m) of shore during nesting season; Avoidance of ordnance testing – line charge testing activities (day and night) during nesting season. VACAPES, Navy Cherry Point, and JAX Range Complexes: Positive control diver-placed mine neutralization and countermeasure activities remain 3.2 nm from estuarine inlets and 1.6 nm from shoreline.
Piping Plover Habitat in Virginia	Activity-specific measures described in the Lookout Procedural Measures and Mitigation Zone Procedural Measures	1 nm from beach in VACAPES Range Complex and 3,000 ft. (914 m) around Fisherman Island during positive control and time-delay diver-placed mine neutralization and countermeasure activities.	1 nm from beach in VACAPES Range Complex and 3,000 ft. (914 m) around Fisherman Island during positive control diver-placed mine neutralization and countermeasure activities.
Gulf Sturgeon Habitat in the Gulf of Mexico	Activity-specific measures described in the Lookout Procedural Measures and Mitigation Zone Procedural Measures	No ordnance testing – line charge testing activities will occur within nearshore Gulf of Mexico waters in Escambia, Santa Rosa, Okaloosa, Walton, Bay, and Gulf counties in Florida from the shoreline to 1 mi. (1.6 km) offshore between October and March (except within the designated line charge testing location on Santa Rosa Island).	No ordnance testing – line charge testing activities will occur within nearshore Gulf of Mexico waters in Escambia, Santa Rosa, Okaloosa, Walton, Bay, and Gulf counties in Florida from the shoreline to 1 mi. (1.6 km) offshore between October and March.

ft: feet; JAX: Jacksonville; km: kilometer; m: meter; mi.: mile; VACAPES: Virginia Capes; yd.: yard

5.5 Monitoring and Reporting

5.5.1 Approach to Monitoring

The Navy is committed to demonstrating environmental stewardship while executing its National Defense Mission and complying with the suite of federal environmental laws and regulations. As a complement to the Navy's commitment to avoiding and reducing impacts of the Proposed Action through mitigation, the Navy will undertake monitoring efforts to track compliance with take authorizations, help evaluate the effectiveness of implemented mitigation measures, and gain a better understanding of the impacts of the Proposed Action on marine resources. Taken together, mitigation and monitoring comprise the Navy's integrated approach for reducing environmental impacts from the Proposed Action. The Navy's overall monitoring approach will seek to leverage and build on existing research efforts whenever possible.

Consistent with the cooperating agency agreement with NMFS, mitigation and monitoring measures presented in this Final EIS/OEIS focus on the requirements for protection and management of marine resources. A well-designed monitoring program can provide important feedback for validating assumptions made in analyses and allow for adaptive management of marine resources. Since monitoring will be required for compliance with the Letters of Authorization issued for the Proposed Action under the MMPA, details of the monitoring program will be developed in coordination with NMFS through the regulatory process. Discussions with resource agencies during the consultation and permitting processes may result in changes to the mitigation as described in this document. Such changes will be reflected in the Records of Decision and consultation documents such as the ESA Biological Opinion.

5.5.1.1 Integrated Comprehensive Monitoring Program

The Integrated Comprehensive Monitoring Program is intended to coordinate monitoring efforts across all regions where the Navy trains and tests and to allocate the most appropriate level and type of effort for each range complex (U.S. Department of the Navy 2010). The current Navy monitoring program is composed of a collection of range-specific monitoring plans, each of which was developed individually as part of MMPA and ESA compliance processes as environmental documentation was completed. These individual plans establish specific monitoring requirements for each range complex or testing range and are collectively intended to address the Integrated Comprehensive Monitoring Plan top-level goals.

A 2010 Navy-sponsored monitoring meeting in Arlington, Virginia, initiated a process to critically evaluate the current Navy monitoring plans and begin development of revisions and updates to both existing region-specific plans as well as the Integrated Comprehensive Monitoring Plan. Discussions at that meeting as well as the following Navy and NMFS annual adaptive management meeting established a way ahead for continued refinement of the Navy's monitoring program. This process included establishing a Scientific Advisory Group of leading marine mammal scientists with the initial task of developing recommendations that would serve as the basis for a Strategic Plan for Navy monitoring. The Strategic Plan is intended to be a primary component of the Integrated Comprehensive Monitoring Program, provide a "vision" for Navy monitoring across geographic regions, and serve as guidance for determining how to most efficiently and effectively invest the marine species monitoring resources to address Integrated Comprehensive Monitoring Plan top-level goals and satisfy MMPA Letter of Authorization regulatory requirements.

The objective of the Strategic Plan is to continue the evolution of Navy marine species monitoring towards a single integrated program, incorporating Scientific Advisory Group recommendations, and establishing a more transparent framework for soliciting, evaluating, and implementing monitoring work across the range complexes and testing ranges. The Strategic Plan must consider a range of factors in addition to the scientific recommendations including logistic, operational, and funding considerations and will be revised regularly as part of the annual adaptive management process.

The Integrated Comprehensive Monitoring Plan establishes top-level goals that have been developed in coordination with NMFS (U.S. Department of the Navy 2010). The following top-level goals will become more specific with regard to identifying potential projects and monitoring field work through the Strategic Plan process as projects are evaluated and initiated in the AFTT Study Area.

- An increase in the understanding of the likely occurrence of marine mammals or ESA-listed marine species in the vicinity of the action (i.e., presence, abundance, distribution, and density of species).
- An increase in the understanding of the nature, scope, or context of the likely exposure of marine mammals and ESA-listed species to any of the potential stressor(s) associated with the action (e.g., tonal and impulsive sound), through better understanding of one or more of the following: (1) the action and the environment in which it occurs (e.g., sound source characterization, propagation, and ambient noise levels); (2) the affected species (e.g., life history or dive patterns); (3) the likely co-occurrence of marine mammals and ESA-listed marine species with the action (in whole or part) associated with specific adverse impacts; or (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).
- An increase in the understanding of how individual marine mammals or ESA-listed marine species respond (behaviorally or physiologically) to the specific stressors associated with the action in specific contexts, where possible (e.g., at what distance or received level).
- An increase in 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).
- An increase in the understanding of the effectiveness of mitigation and monitoring measures.
- A better understanding and record of the manner in which the authorized entity complies with the Incidental Take Authorization and Incidental Take Statement.
- An increase in the probability of detecting marine mammals (through improved technology or methods), both specifically within the mitigation zone (thus allowing for more effective implementation of the mitigation) and in general, to better achieve the above goals.
- A reduction in the adverse impact of activities to the least practicable level, as defined in the MMPA.

5.5.1.2 Scientific Advisory Group Recommendations

Navy established the Scientific Advisory Group in 2011 with the initial task of evaluating current Navy monitoring approaches under the Integrated Comprehensive Monitoring Plan and existing MMPA Letters of Authorization and developing objective scientific recommendations that would form the basis for the Strategic Plan. While recommendations were fairly broad and not prescriptive from a range complex perspective, the Scientific Advisory Group did provide specific programmatic recommendations that serve as guiding principles for the continued evolution of the Navy Marine Species Monitoring

Program and provide a direction for the Strategic Plan to move this development. Key recommendations include:

- 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 a "box-checking" mentality. Monitoring studies should be designed and conducted according to scientific objectives, rather than on merely cataloging effort expended.
- Approach the monitoring program holistically and select projects that offer the best opportunity to advance understanding of the issues, as opposed to establishing range-specific requirements.

5.5.2 REPORTING

The Navy is committed to documenting and reporting relevant aspects of training and testing activities to verify implementation of mitigation, comply with current permits, and improve future environmental assessments. Navy reporting initiatives are described below.

5.5.2.1 Exercise, Testing, and Monitoring Reporting

The Navy will submit annual exercise, testing, and monitoring reports to the Office of Protected Resources at NMFS. The exercise reports will describe the level of training and testing conducted during the reporting period, and the monitoring reports will describe both the nature of the monitoring that has been conducted and the actual results of the monitoring. All of the details regarding the content of the annual reports will be coordinated with NMFS through the permitting process. All reports submitted to date can be found on the NMFS Office of Protected Resources webpage.

5.5.2.2 Stranding Response Plan

In coordination with NMFS, the Navy will have a stranding response plan. All of the details regarding the content of the stranding response plan will be coordinated with NMFS through the permitting process.

5.5.2.3 Bird Strike Reporting

The Navy will report all damaging and non-damaging bird strikes to the Naval Safety Center.

5.5.2.4 Marine Mammal Incident Reporting

If any injury or death of a marine mammal is observed during training or testing activities, the Navy will immediately halt the activity and report the incident, including dead or injured animals, to NMFS, the U.S. Fish and Wildlife Service, or the Florida Fish and Wildlife Conservation Commission as appropriate.

If any harassment, injury, or death of a manatee is observed during training and testing activities, the Navy will immediately halt the activity and report the incident (including dead or injured animals). Depending on the location of the incident, the Navy will make a report to one or more agencies as appropriate, which may include NMFS; the Florida Fish and Wildlife Conservation Commission, Law Enforcement Division; the U.S. Fish and Wildlife Service, Jacksonville Ecological Field Office; the U.S. Fish and Wildlife Service, Raleigh Field Office; and the North Carolina Wildlife Resources Commission.

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6 ADDITIONAL 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 APPLICABLE LAWS, EXECUTIVE ORDERS, INTERNATIONAL STANDARDS, AND GUIDANCE

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 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. Section 3.0.1 (Regulatory Framework) provides brief excerpts of the federal statutes, executive orders, international standards, and guidance that form the regulatory framework for evaluation of the resources that appeared in Chapter 3 (Affected Environment and Environmental Consequences). Documentation of consultation and coordination with regulatory agencies is provided in Appendix C (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	
Act to Prevent Pollution from Ships (33 United States Code [U.S.C.] §§ 1901-1915)	Requirements associated with the Act to Prevent Pollution from Ships are implemented by 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 regulations and operates in a manner that minimizes or eliminates any adverse effects to the marine environment. See Section 3.1 (Sediments and Water Quality) for the assessment.
Antiquities Act (16 U.S.C. §§ 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. §§ 1451-1464)	The Navy submitted coastal consistency determinations to those states and territories whose coastal uses or resources may be affected by the Proposed Action.
Historic Sites Act (16 U.S.C. §§ 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.

Table 6.1-1: Summary of Environmental Compliance for the Proposed Action (Continued)

Laws, Executive Orders, International Standards, and Guidance	Status of Compliance
Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. §§ 1801–1882)	The Navy prepared an Essential Fish Habitat Assessment. The Proposed Action may have potential impacts on essential fish habitat and managed species. Consultation with NMFS was conducted for affected species and their habitats. The Essential Fish Habitat Assessment was prepared as a separate document.
Migratory Bird Treaty Act (16 U.S.C. §§ 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. See Section 3.6 (Birds) for the assessment.
National Fishery Enhancement Act (33 U.S.C. §§ 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. See Section 3.9 (Fish) for the assessment.
National Marine Sanctuaries Act (16 U.S.C. §§ 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 6.1.2.5 (National Marine Sanctuaries).
Submerged Lands Act of 1953 (43 U.S.C. §§ 1301–1315)	In accordance with the coastal states' regulations, the Proposed Action is consistent with regulations concerning the Submerged Lands Act.
Sunken Military Craft Act (Public Law 108–375, 10 U.S.C. § 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. §§ 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 (EO) 11990, *Protection of Wetlands*	In accordance with Navy procedures, implementation of the Proposed Action would not affect wetlands as defined in Executive Order 11990.
Executive Order 12114, *Environmental Effects Abroad of Major Department of Defense Actions*	The Navy prepared this OEIS in accordance with EO 12114 and Navy-implementing regulations found at 32 Code of Federal Regulations (C.F.R.) Part 187, *Environmental Effects Abroad of Major Department of Defense Actions*.
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 3.0.5.2 (Resources and Issues Eliminated from Further Consideration).
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 (Socioeconomic Resources) 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 3.0.5.2 (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 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 implementation of measures needed to research, monitor, manage, and restore them, including reducing impacts from pollution and sedimentation. See Section 3.3 (Marine Habitats) 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 C.F.R. Part 151 Subpart D, *Ballast Water Management for Control of Nonindigenous Species in Waters of the United States*.
Executive Order 13158, *Marine Protected Areas*	The Navy has prepared this EIS/OEIS in accordance with requirements for the protection of existing national system 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 8.0 (Distribution List) for federally-recognized tribes that were provided notification letters of the AFTT EIS/OEIS.
Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*	In accordance with Navy procedures, the Proposed Action is consistent with the integrated strategy toward sustainability in the federal government and to making reduction of greenhouse gas emissions a priority for federal agencies.
Executive Order 13547, *Stewardship of the Ocean, Our Coasts, and the Great Lakes*	In accordance with Navy procedures, the Proposed Action is consistent with the comprehensive national policy for the Stewardship of the Ocean, Our Coasts, and the Great Lakes.
INTERNATIONAL STANDARDS	
International Convention for the Prevention of Pollution from Ships	This standard prohibits certain discharges of oil, garbage, and other substances from vessels. The convention and its annexes are implemented by national legislation, including the Act to Prevent Pollution from Ships (33 U.S.C. §§ 1901 to 1915) and the Federal Water Pollution Control Act (33 U.S.C. §§ 1321 to 1322). The Proposed Action does not include vessel operation and discharge from ships; however, Navy vessels operating in the Study Area would comply with the discharge requirements established in this program, minimizing or eliminating potential impacts from discharges from ships.

Table 6.1-1: Summary of Environmental Compliance for the Proposed Action (Continued)

Laws, Executive Orders, International Standards, and Guidance	Status of Compliance
GUIDANCE	
Military Munitions Rule	The Military Munitions Rule identifies when conventional and chemical military munitions are considered solid waste under the Resource Conservation and Recovery Act (42 U.S.C. §§ 6901-6992k). Military munitions are not considered solid waste based on two conditions stated at 40 C.F.R. § 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.

6.1.1 Coastal Zone Management Act Compliance

The Coastal Zone Management Act of 1972 (16 U.S.C. §§ 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 resource are required to be consistent, to the maximum extent practicable, with the enforceable policies of approved Coastal Management Plans. See Section 4.3.8 (Development of Coastal Lands) for further information.

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 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 shoreward extent is not relevant to the Proposed Action.

A consistency determination, a negative determination, or a d*e minimis* exemption may be submitted for review of federal agency activities. A federal agency submits a consistency determination when it determines that its activity may have either a direct or an indirect effect on a state coastal use or resource. In accordance with 15 C.F.R. § 930.39, the consistency determination will 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. The consistency determination should be based on evaluation of the relevant enforceable policies of the management program. In accordance with 15 C.F.R. § 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 § 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 reviewed the enforceable policies of each state's federally approved Coastal Zone Management Plan relevant to the Study Area. There are 18 states (Alabama, Connecticut, Delaware, Florida, Georgia, Louisiana, Maine, Maryland, Massachusetts, Mississippi, New Hampshire, New Jersey, New York, North Carolina, Rhode Island, South Carolina, Texas, and Virginia) and two U.S. territories (Puerto Rico and U.S. Virgin Islands) whose coastal zones could be affected by the Proposed Action. 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 C.F.R. § 930.39, the Navy prepared consistency determinations. Consistency determinations for each state adjacent to the Study Area are available for public viewing on the project web site. Coastal Zone Management Act correspondence with the states is presented in Appendix C, Agency Correspondence.

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 (EO) 13158, *Marine Protected Areas* (Federal Register (FR) 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 and map of areas accepted in the national system of marine protected areas is available from the National Marine Protected Areas Center (National Marine Protected Areas Center 2011). EO 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 EO 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. 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 EO 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 through 3.9 (Sediments and Water Quality, Air Quality, Marine Habitats, Marine Mammals, Sea Turtles and Other Marine Reptiles, Birds, Marine Vegetation, Marine Invertebrates, and Fish). In accordance with EO 13158, the Navy has considered the potential impacts of its proposed activities under the Preferred Alternative (Alternative 2) to the national system marine protected areas that contain marine waters within the Study Area.

Table 6.1-2 presents information on the national system 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; however, due to the nature of these activities (e.g., requiring deep water), they are unlikely to occur in the extremely shallow nearshore waters typical of most marine protected areas. These activities include:

- anti-air warfare testing (air combat maneuver test; air platform/vehicle testing; intelligence, surveillance, and reconnaissance);
- testing and evaluation of catapult launch;
- new ship construction and maintenance testing (propulsion testing, littoral combat ship mission package testing–surface warfare), excluding pierside testing;
- anti-surface/anti-submarine warfare testing (missile testing, torpedo [explosive] testing, counter-measure testing/acoustic systems testing);
- hydrodynamic testing;
- anti-submarine tracking exercise/torpedo exercise;
- anti-air and anti-surface gunnery exercise; and
- torpedo testing.

Because the activities listed above are unlikely to occur in shallow nearshore waters, the impacts of such activities to 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, with area-specific prohibitions listed in Table 6.1-2, where applicable.

Table 6.1-2: National System Marine Protected Areas within the Study Area

Marine Protected Area	Location within the Study Area	Protection Focus	Summary of Relevant Regulations	Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations
Northeast U.S. Continental Shelf Large Marine Ecosystem				
Assateague Island National Seashore	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) (National Park Service 2011a)	Prohibited: personal watercraft beaching on the ocean side of the island unless in an emergency (36 C.F.R. § 7.65 (National Park Service 2011a).	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.
Lydonia Canyon Gear Restricted Area	Massachusetts: Other AFTT Areas	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; see the Essential Fish Habitat Assessment for a map and detailed analysis of this area.
Monomoy National Wildlife Refuge	Massachusetts: Within 2 nm of Boston OPAREA, Northeast Range Complexes	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 2011b).	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.
Oceanographer Canyon Gear Restricted Area	Massachusetts: Other AFTT Areas	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; see the Essential Fish Habitat Assessment for a map and detailed analysis of this area.

AFTT: Atlantic Fleet Training and Testing; C.F.R.: Code of Federal Regulations; nm: nautical mile; OPAREA: Operating Area; VACAPES: Virginia Capes
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.
National Marine Sanctuaries are not included in this table and are discussed in detail in Section 6.1.2.5 (National Marine Sanctuaries).

Table 6.1-2: National System Marine Protected Areas within the Study Area (Continued)

Marine Protected Area	Location within the Study Area	Protection Focus	Summary of Relevant Regulations	Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations
Northeast U.S. Continental Shelf Large Marine Ecosystem (Continued)				
Veatch Canyon Gear Restricted Area	Massachusetts: Within W-105 of the Narragansett Bay OPAREA, Northeast Range Complexes	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; see the Essential Fish Habitat Assessment for a map and detailed analysis of this area.
Jacques Cousteau Estuarine Research Reserve	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, and fish)	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.
Gateway National Recreational Area	New Jersey/New York: 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 between15 March and Labor Day; vessel operations within Spermaceti Cove or within 46 m (150 ft.) of marshes (36 C.F.R. § 1.5) (National Park Service 2011b). National Park Service Management Policies (2006) apply (36 C.F.R. § 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.

AFTT: Atlantic Fleet Training and Testing; C.F.R.: Code of Federal Regulations; nm: nautical mile; OPAREA: Operating Area

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.

National Marine Sanctuaries are not included in this table and are discussed in detail in Section 6.1.2.5 (National Marine Sanctuaries).

Table 6.1-2: National System Marine Protected Areas within the Study Area (Continued)

Marine Protected Area	Location within the Study Area	Protection Focus	Summary of Relevant Regulations	Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations
Northeast U.S. Continental Shelf Large Marine Ecosystem (Continued)				
Blue Crab Sanctuary	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	Blue crab (*Callinectes sapidus*)	State regulations apply. Harvest restrictions are not applicable to Navy activities (Virginia Marine Resources Commission 2011).	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	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 n.d.).	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.
Fisherman Island National Wildlife Refuge	Virginia: Lower Chesapeake Bay; 1 nm from mine warfare training area	Ecosystem (migratory birds)	Prohibited: commercial and recreational fishing.	The resources protected by this area could be briefly exposed to aircraft overflights; however, there is a mitigation measure in place that states helicopters will avoid overflying Fisherman Island National Wildlife Refuge off the coast of Cape Charles, Virginia by at least 3,000 ft. (914 m) vertically and horizontally to avoid disturbing piping plovers and other birds. Therefore, no impacts are expected within Fisherman Island National Wildlife Refuge.

ft.: feet; m: meter; nm: nautical mile; OPAREA: Operating Area; VACAPES: Virginia Capes
Note: National Marine Sanctuaries are not included in this table and are discussed in detail in Section 6.1.2.5 (National Marine Sanctuaries).

Table 6.1-2: National System Marine Protected Areas within the Study Area (Continued)

Marine Protected Area	Location within the Study Area	Protection Focus	Summary of Relevant Regulations	Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations
Northeast U.S. Continental Shelf Large Marine Ecosystem (Continued)				
Norfolk Canyon Gear Restricted Area	Virginia: Overlaps W-386 of the VACAPES OPAREA (Surface Area Grid 8C)	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; see the Essential Fish Habitat Assessment for a map and detailed analysis of this area.
Southeast U.S. Continental Shelf Large Marine Ecosystem				
Biscayne National Park	Florida: Other AFTT Areas, bordering South Florida Ocean Measurement Facility Testing Range	Ecosystem (corals, sea turtles, smalltooth sawfish [*Pristis pectinata*], West Indian manatee [*Trichechus manatus*], 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.

AFTT: Atlantic Fleet Training and Testing; OPAREA: Operating Area; VACAPES: Virginia Capes
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.
National Marine Sanctuaries are not included in this table and are discussed in detail in Section 6.1.2.5 (National Marine Sanctuaries).

Table 6.1-2: National System Marine Protected Areas within the Study Area (Continued)

Marine Protected Area	Location within the Study Area	Protection Focus	Summary of Relevant Regulations	Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations
Southeast U.S. Continental Shelf Large Marine Ecosystem (Continued)				
Guana Tolomato Matanzas National Estuarine Research Reserve	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 • 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.
Cape Romain National Wildlife Refuge	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: bearing weapons, except during open hunting seasons and in open hunt areas (U.S. Fish and Wildlife Service 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 Cape Romain National Wildlife Refuge.

AFTT: Atlantic Fleet Training and Testing; JAX: Jacksonville; nm: nautical mile; OPAREA: Operating Area
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.
National Marine Sanctuaries are not included in this table and are discussed in detail in Section 6.1.2.5 (National Marine Sanctuaries).

Table 6.1-2: National System Marine Protected Areas within the Study Area (Continued)

Marine Protected Area	Location within the Study Area	Protection Focus	Summary of Relevant Regulations	Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations
Gulf of Mexico Large Marine Ecosystem				
Cedar Keys National Wildlife Refuge	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; carrying, possessing, or discharging firearms, fireworks, or explosives, or other weapons (except for hunting purposes as allowed under state regulations). Closed areas: interiors of all islands (except Atsena Otie Key). Seahorse Key and a 300 ft. (91 m) zone around the island is closed to all public entry from 1 March until 30 June (U.S. Fish and Wildlife Service 2010).	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.
Chassahowitzka National Wildlife Refuge	Florida: Other AFTT Areas	Ecosystem (estuarine habitat, waterfowl, West Indian manatees [*Trichechus manatus*])	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 2003).	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.

AFTT: Atlantic Fleet Training and Testing; ft.: feet; m: meters
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.
National Marine Sanctuaries are not included in this table and are discussed in detail in Section 6.1.2.5 (National Marine Sanctuaries).

Table 6.1-2: National System Marine Protected Areas within the Study Area (Continued)

Marine Protected Area	Location within the Study Area	Protection Focus	Summary of Relevant Regulations	Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations
Gulf of Mexico Large Marine Ecosystem (Continued)				
Dry Tortugas National Park	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 C.F.R. § 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 Operating 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	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 C.F.R. § 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.

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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.
National Marine Sanctuaries are not included in this table and are discussed in detail in Section 6.1.2.5 (National Marine Sanctuaries).

Table 6.1-2: National System Marine Protected Areas within the Study Area (Continued)

Marine Protected Area	Location within the Study Area	Protection Focus	Summary of Relevant Regulations	Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations
Gulf of Mexico Large Marine Ecosystem (Continued)				
Great White Heron National Wildlife Refuge	Florida: Other AFTT Areas, within 10 nm of Key West OPAREA and Key West Range Complex	Ecosystem (wading birds, coral reefs)	Prohibited: weapons, unless cased and left in vehicles/ boats; feeding/molesting wildlife; storing equipment on refuge lands. Personal watercraft allowed in designated areas only (U.S. Fish and Wildlife Service 1994). Closed areas: all refuge-managed islands; public access is limited to state-owned islands during daylight hours (U.S. Fish and Wildlife Service n.d.-b).	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.
Key West National Wildlife Refuge	Florida: Bordering Key West OPAREA and Key West Range Complex	Breeding grounds for native birds and other wildlife	Prohibited: weapons, unless cased and left in vehicles/ boats; feeding/molesting wildlife; storing equipment on refuge lands. Personal watercraft in designated areas only (U.S. Fish and Wildlife Service 1994).	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	Florida: Other AFTT Areas	Ecosystem (West Indian manatees, Gulf sturgeon [*Acipenser oxyrinchus desotoi*], shorebirds and wading birds)	Prohibited: injuring, disturbing, or destroying any plant or animal; carrying, possessing, or discharging firearms, fireworks, explosives, or other weapons (except for hunting as allowed under state regulations) (U.S. Fish and Wildlife Service 2010).	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.

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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.
National Marine Sanctuaries are not included in this table and are discussed in detail in Section 6.1.2.5 (National Marine Sanctuaries).

Table 6.1-2: National System Marine Protected Areas within the Study Area (Continued)

Marine Protected Area	Location within the Study Area	Protection Focus	Summary of Relevant Regulations	Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations
Gulf of Mexico Large Marine Ecosystem (Continued)				
National Key Deer Refuge	Florida: Other AFTT Areas (within 10 nm of Key West OPAREA and Key West Range Complex)	Protect and preserve Key deer (*Odocoileus virginianus clavium*) and other wildlife resources in the Florida Keys	Prohibited: weapons, unless cased and left in vehicles/boats; feeding/molesting wildlife; storing equipment on refuge lands. Personal watercraft in designated areas only (U.S. Fish and Wildlife Service 1994).	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.
Rookery Bay National Estuarine Research Reserve	Florida: Other AFTT Areas (within 10 nm of W-174 of Key West Range Complex)	Ecosystem (birds, fish, manatees, 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 (Rookery Bay National Estuarine Research Reserve 2000).	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.
St. Marks National Wildlife Refuge	Florida: Other AFTT Areas	Ecosystem (shorebirds, marine mammals, American alligator [*Alligator mississippiensis*], sea turtles)	Prohibited: taking government property or any natural feature, artifact, animal or plant; bearing weapons or firearms (U.S. Fish and Wildlife Service 1999).	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.

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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.
National Marine Sanctuaries are not included in this table and are discussed in detail in Section 6.1.2.5 (National Marine Sanctuaries).

Table 6.1-2: National System Marine Protected Areas within the Study Area (Continued)

Marine Protected Area	Location within the Study Area	Protection Focus	Summary of Relevant Regulations	Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations
Gulf of Mexico Large Marine Ecosystem (Continued)				
Ten Thousand Islands National Wildlife Refuge	Florida: Other AFTT Areas	Ecosystem (birds, manatees, sea turtles, mangroves)	Prohibited: disturbing any plants or animals; removing any artifacts (U.S. Fish and Wildlife Service n.d.-c).	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 Island National Wildlife Refuge.
Breton National Wildlife Refuge	Louisiana: Other AFTT Areas	Ecosystem (nesting or wintering birds)	Prohibited: landing a plane or helicopter on refuge land; entry into the nesting areas and any disturbance of the nesting colonies (U.S. Fish and Wildlife Service n.d.-a).	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.
Delta National Wildlife Refuge	Louisiana: Other AFTT Areas	Ecosystem (waterfowl, American alligator)	No area-specific regulations apply to Navy activities (U.S. Fish and Wildlife Service 2011a).	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	Louisiana: Other AFTT Areas	Ecosystem (nesting birds)	Public access is restricted; areas will be closed when nesting has occurred (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.

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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.
National Marine Sanctuaries are not included in this table and are discussed in detail in Section 6.1.2.5 (National Marine Sanctuaries).

Table 6.1-2: National System Marine Protected Areas within the Study Area (Continued)

Marine Protected Area	Location within the Study Area	Protection Focus	Summary of Relevant Regulations	Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations
Caribbean Sea Large Marine Ecosystem				
Buck Island Reef National Monument	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 C.F.R. § 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.
Jobos Bay National Estuarine Research Reserve	Puerto Rico: Other AFTT Areas	Ecosystem (mangroves, seagrass beds, coral reefs, manatees, sea turtles)	All boats using anchors will be restricted to areas specifically designated for that purpose. Vessels with a maximum size of 22.0 ft. (6.7 m) are permitted to transit in Conservation Sectors and Limited Use Sectors. No motor vessels will be allowed in Preservation Sectors, with the exception of researchers and shellfish fishermen (Laboy et al. 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.
St. Croix East End Marine Park	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 2005).	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.

AFTT: Atlantic Fleet Training and Testing; C.F.R.: Code of Federal Regulations; ft.: feet; m: meters; U.S.: United States
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.
National Marine Sanctuaries are not included in this table and are discussed in detail in Section 6.1.2.5 (National Marine Sanctuaries).

Table 6.1-2: National System Marine Protected Areas within the Study Area (Continued)

Marine Protected Area	Location within the Study Area	Protection Focus	Summary of Relevant Regulations	Navy Proposed Activities Under the Preferred Alternative and Marine Protected Area Considerations
Caribbean Sea Large Marine Ecosystem (Continued)				
Salt River Bay National Historic Park and Ecological Preserve	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	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 C.F.R. § 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.
North Atlantic Gyre Open Ocean Area				
Virgin Islands National Park	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 C.F.R. § 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.

Source: List of national system marine protected areas in the Study Area and their protection focuses (National Marine Protected Areas Center 2011)
AFTT: Atlantic Fleet Training and Testing; C.F.R.: Code of Federal Regulations; OPAREA: Operating Area; U.S.: United States
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.
National Marine Sanctuaries are not included in this table and are discussed in detail in Section 6.1.2.5 (National Marine Sanctuaries).

6.1.2.1 National Estuarine Research Reserves

National Estuarine Research Reserve System sites protect estuarine land and water and provide habitat for wildlife; educational opportunities for students, teachers, and the public; and serve as laboratories for scientists (15 C.F.R. Part 921). The National Estuarine Research Reserve Program is administered in coordination with the National Marine Sanctuary System. Each reserve is managed by a state agency on a site-specific basis.

6.1.2.2 National Parks

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.

6.1.2.3 National Wildlife Refuges

Refuges are managed by the U.S. Fish and Wildlife Service in accordance with EO 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 U.S. Fish and Wildlife Service 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 2006).

6.1.2.4 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 for 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.

6.1.2.5 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. Sanctuary regulations prohibit destroying, causing the loss of, or injuring any sanctuary resource managed under the law or regulations for that sanctuary (15 C.F.R. Part 922). National marine sanctuaries are managed on a site-specific basis, and military exemptions vary. The national marine sanctuaries within the Study Area are mapped in Figures 6.1-1, 6.1-2, and 6.1-3. They are described in additional detail below.

6.1.2.5.1 Gerry E. Studds Stellwagen Bank National Marine Sanctuary

The Gerry E. Studds Stellwagen Bank National Marine Sanctuary is located within in 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 6.1-1). The sanctuary includes an area of nearly 638 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, and North Atlantic right whale. Human uses of the Gerry E. Studds Stellwagen Bank National Marine Sanctuary include commercial shipping, recreational fishing, whale watching, and diving.

General regulations for the Gerry E. Studds Stellwagen Bank National Marine Sanctuary prohibit the following (15 C.F.R. § 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.

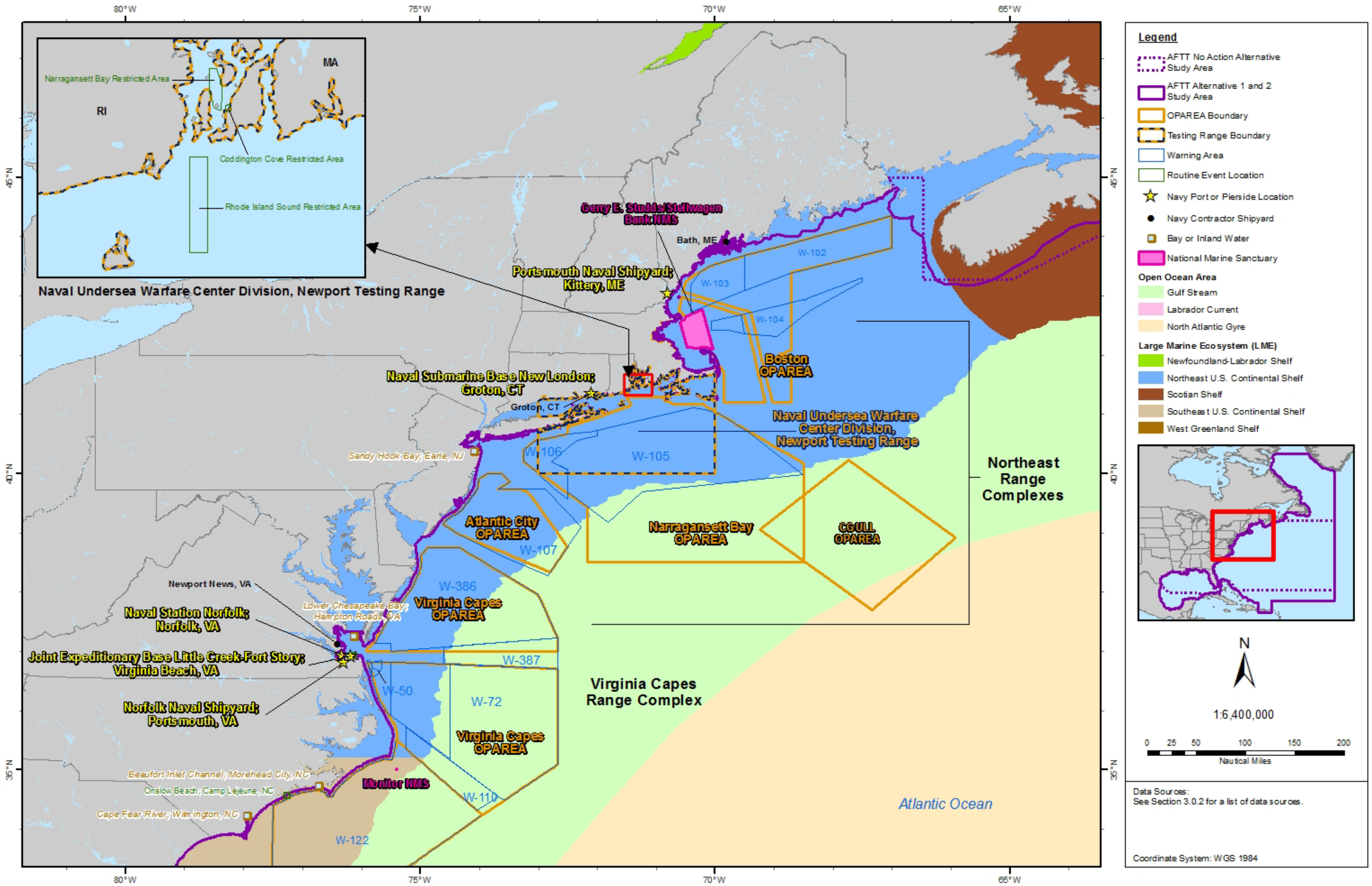

Figure 6.1-1: Location of National Marine Sanctuaries within the Mid-Atlantic Region of the Study Area

AFTT: Atlantic Fleet Training and Testing; CT: Connecticut; MA: Massachusetts; ME: Maine; NC: North Carolina; NJ: New Jersey; NMS: National Marine Sanctuary; OPAREA: Operating Area; RI: Rhode Island

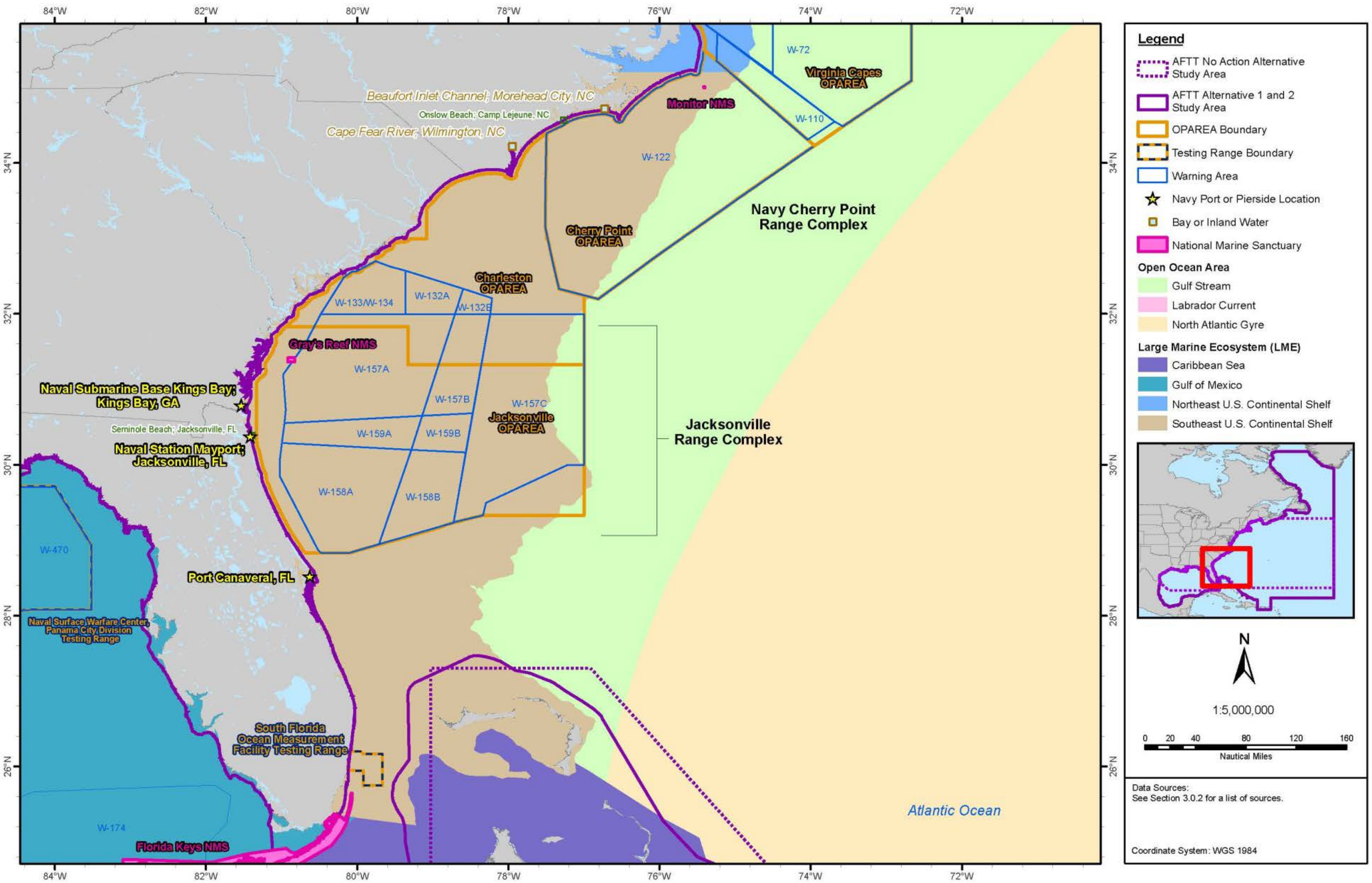

Figure 6.1-2: Location of National Marine Sanctuaries within the Southeast Atlantic Region of the Study Area

AFTT: Atlantic Fleet Training and Testing; FL: Florida; GA: Georgia; NMS: National Marine Sanctuary; OPAREA: Operating Area

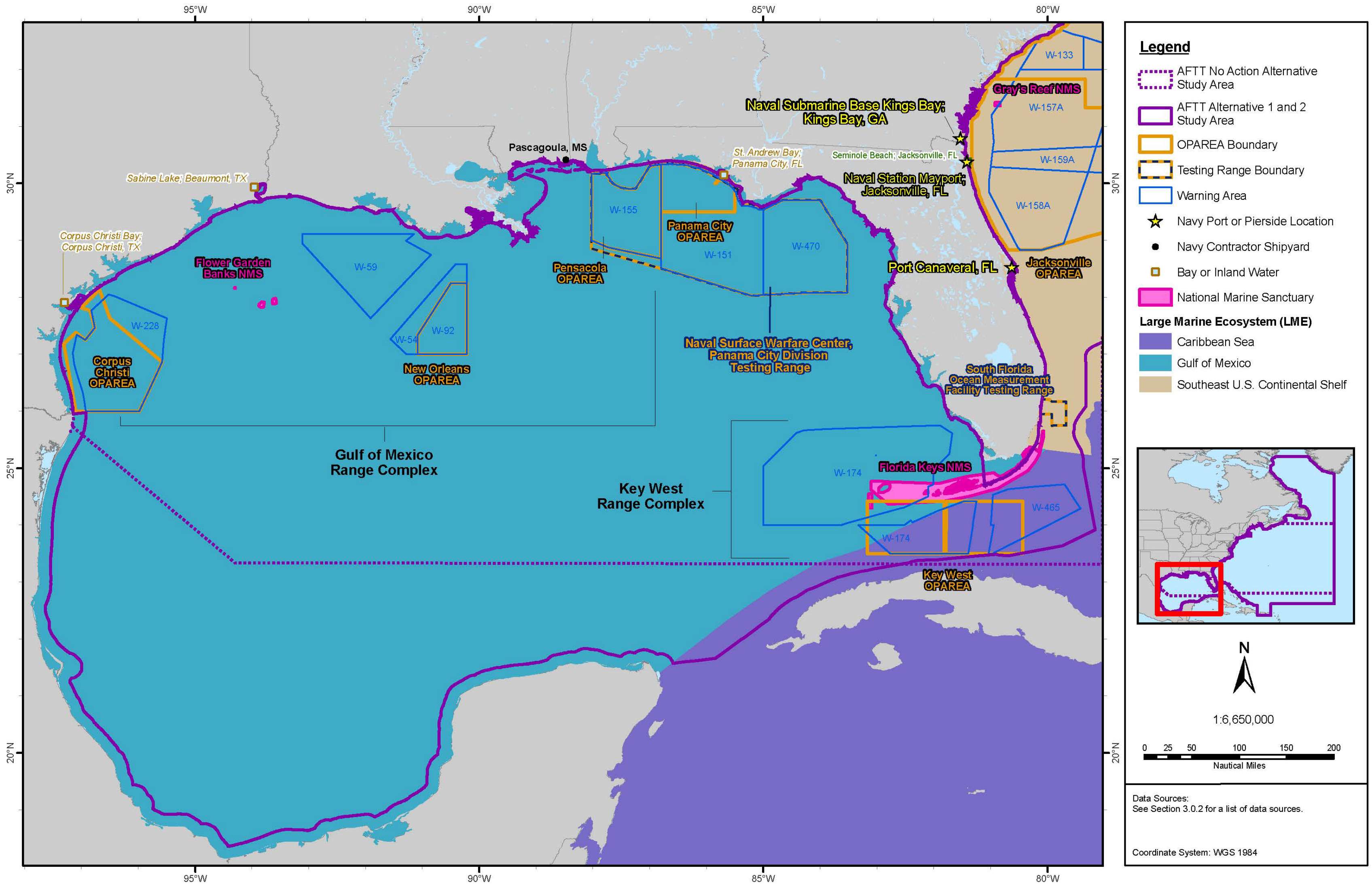

Figure 6.1-3: Location of National Marine Sanctuaries within the Gulf of Mexico Region of the Study Area

AFTT: Atlantic Fleet Training and Testing; FL: Florida; GA: Georgia; MS: Mississippi; NMS: National Marine Sanctuary; OPAREA: Operating Area; TX: Texas

(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 Gerry E. Studds Stellwagen Bank National Marine Sanctuary does not have specific military exemptions from the applicable National Marine Sanctuary Program Regulations. The regulations simply 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 C.F.R. § 922.142(c)(1)(i)). Activities carried out by the DoD may be exempted from certain sanctuary prohibitions after consultation with the Office of National Marine Sanctuaries (15 C.F.R. § 922.142(c)(1)(ii)).

The Stellwagen Bank National Marine Sanctuary Management Plan and Environmental Assessment was released in June 2010 (Office of National Marine Sanctuaries 2010). It states:

> DoD's U.S. Navy seldom conducts operations in the sanctuary, due to the shallow depths which are unsuitable for submarine operations, and the crowded waters which make warfare training exercises inadvisable. Naval ships transit the sanctuary approximately seven times a year primarily to access the Port of Boston and in so doing follow internal protocols of posting a lookout for whales and avoiding discharges in the sanctuary (Tom Fetherston, U.S. Navy, personal communication, 2004). Operations in deep waters (greater than 200 m) beyond the sanctuary have the potential to acoustically disturb sanctuary resources.

To ensure compliance with the National Marine Sanctuary Program Regulations, the Navy considered all proposed training and testing activities to determine which activities are likely to destroy, cause the loss of, or injure sanctuary resources or qualities. 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 Gerry E. Studds Stellwagen Bank National Marine Sanctuary, because they (1) are not likely to destroy, cause the loss of, or injure sanctuary resources or qualities, or (2) are carried out in a manner that avoids to the maximum extent practicable any adverse impacts on sanctuary resources and qualities (15 C.F.R. § 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, sea turtles, or fish 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. The Navy implements standard operating procedures that require pilots of Navy aircraft to make every attempt to avoid birds in order to reduce the safety risk involved with a potential bird strike. For a more detailed discussion of potential impacts to these resources from the use of aircraft and aerial targets, see the following sections:

- Section 3.4.3.1.14 (Impacts from Aircraft Noise) for marine mammals
- Section 3.5.3.1.12 (Impacts from Vessel and Aircraft Noise) for sea turtles
- Section 3.6.3.1.5 (Impacts from Aircraft and Vessel Noise) and Section 3.6.3.3.1 (Impacts from Aircraft and Aerial Targets) for birds, which includes discussion of applicable seabirds
- Section 3.9.3.1.2 (Impacts from Sonar and Other Non-Impulsive Acoustic Sources) for fish

▪ 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, sea turtles, seabirds, or fish 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. However, the Navy implements mitigation measures to reduce the potential for vessel strikes of marine mammals (Section 5.3.2.2, Physical Disturbance and Strikes, and Section 5.3.3.1, Marine Mammal Habitats). In addition, all vessels use extreme caution and proceed at a “safe speed” so they can take proper and effective action to avoid a collision with any sighted object or disturbance, and can be stopped within a distance appropriate to the prevailing circumstances and conditions. 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 3.4.3.3.1 (Impacts from Vessels) and Section 3.4.3.3.2 (Impacts from In-Water Devices) for marine mammals
- Section 3.5.3.3.1 (Impacts from Vessels) and Section 3.5.3.3.2 (Impacts from In-Water Devices) for sea turtles
- Section 3.6.3.3.2 (Impacts from Vessels and In-Water Devices) for birds
- Section 3.7.3.2.1 (Impacts from Vessels and In-Water Devices) for vegetation
- Section 3.8.3.3.1 (Impacts from Vessels and In-Water Devices) for invertebrates
- Section 3.9.3.3.1 (Impacts from Vessels and In-Water Devices) for fish

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

Activities the Navy proposes to conduct in 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. 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 are likely to destroy, cause the loss of, or injure sanctuary resources or qualities. Further, the Navy does not proposed to increase the level of existing activities within the sanctuary from what was previously considered at the time of sanctuary designation.

6.1.2.5.2 Gray's Reef National Marine Sanctuary

The Gray's Reef National Marine Sanctuary is located within in the Southeast U.S. Continental Shelf Large Marine Ecosystem 17.5 nm off Sapelo Island, Georgia (Figure 6.1-2). 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 (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 180 species, including black sea bass, snapper, grouper, and mackerel.

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 C.F.R. § 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.

(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 any vessel in the sanctuary, except as provided in § 922.92 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.

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 ft. [457 m] or beyond a 1 nm radius of the sanctuary). The exemption does not apply to new activities that could potentially have significant impacts, which would require consultation with the Office of National Marine Sanctuaries (15 C.F.R. § 922.92(b)).

The Gray's Reef National Marine Sanctuary Final Management Plan/Final Environmental Impact Statement was released in July 2006 (National Marine Sanctuary Program 2006). It states:

> The Department of Defense has a general exemption from GRNMS [Gray's Reef National Marine Sanctuary] regulations. The Sanctuary lies within the western edge of the Navy's Jacksonville Fleet Operating Area W-157, where training operations are conducted. Although use of this area can be intense and include surface and aerial gunnery, bombing, torpedo, and missile activity, as well as ship and submarine maneuvers, these activities have not affected the Sanctuary in the past. Military aircraft do not fly below 1500 feet or within a one nautical mile radius of the Sanctuary in order to minimize disturbance of marine resources.

To ensure compliance with the National Marine Sanctuary Program Regulations, the Navy considered all proposed training and testing activities to determine which activities could potentially have significant impacts on sanctuary resources. The Navy concluded that the proposed activities could fall into the following three 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 specifically exempted:

- Aircraft and Aerial Targets

Aircraft and aerial targets are expected to cause only a minor and temporary behavioral reaction due to noise for marine mammals, sea turtles, birds, or fish 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. The Navy implements standard operating procedures that require pilots of Navy aircraft to make every attempt to avoid birds in order to reduce the safety risk involved with a potential bird strike. For a more detailed discussion of potential impacts to these resources from the use of aircraft and aerial targets, see the following sections:

- Section 3.4.3.1.14 (Impacts from Aircraft Noise) for marine mammals
- Section 3.5.3.1.12 (Impacts from Vessel and Aircraft Noise) for sea turtles
- Section 3.6.3.1.5 (Impacts from Aircraft and Vessel Noise) and Section 3.6.3.3.1 (Impacts from Aircraft and Aerial Targets) for birds, which includes discussion of applicable seabirds
- Section 3.9.3.1.2 (Impacts from Sonar and Other Non-Impulsive Acoustic Sources) for fish

- 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, sea turtles, seabirds, or fish 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. However, the Navy implements mitigation measures to reduce the potential for vessel strikes of marine mammals (Section 5.3.2.2, Physical Disturbance and Strikes, and Section 5.3.3.1, Marine Mammal Habitats). In addition, all vessels use extreme caution and proceed at a "safe speed" so they can take proper and effective action to avoid a collision with any sighted object or disturbance, and can be stopped within a distance appropriate to the prevailing circumstances and conditions. 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 3.4.3.3.1 (Impacts from Vessels) and Section 3.4.3.3.2 (Impacts from In-Water Devices) for marine mammals
- Section 3.5.3.3.1 (Impacts from Vessels) and Section 3.5.3.3.2 (Impacts from In-Water Devices) for sea turtles
- Section 3.6.3.3.2 (Impacts from Vessels and In-Water Devices) for birds
- Section 3.7.3.2.1 (Impacts from Vessels and In-Water Devices) for vegetation
- Section 3.8.3.3.1 (Impacts from Vessels and In-Water Devices) for invertebrates
- Section 3.9.3.3.1 (Impacts from Vessels and In-Water Devices) for fish

- 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 fish that may be present in the area. Impacts are expected to range from temporary behavioral reactions to injury, damage, or death. However, the Navy implements mitigation measures to reduce the potential for impacts from the use of explosives (Section 5.3.1.2.2, Acoustic Stressors—Explosives and Impulsive Sound, and Section 5.3.2.1.2, Explosives and Impulsive Sound). 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 3.4.3.1.9 (Impacts from Explosives) for marine mammals
- Section 3.5.3.1.8 (Impacts from Explosives) for sea turtles
- Section 3.6.3.1.2 (Impacts from Explosives and Swimmer Defense Airguns) for birds
- Section 3.7.3.1.1 (Impacts from Explosives) for vegetation
- Section 3.8.3.1.2 (Impacts from Explosives and Other Impulsive Acoustic Sources) for invertebrates
- Section 3.9.3.1.3 (Impacts from Explosives and Other Impulsive Acoustic Sources) for fish

- 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 fish that may be present in the area. However, the probability of military expended materials directly striking a marine resource is extremely low. In addition, the Navy implements mitigation measures to reduce the potential for direct strike from non-explosive practice munitions (Section 5.3.1.2.3, Physical Disturbance and Strikes, and Section 5.3.2.2.2, Non-Explosive Practice Munitions). In addition to biological resources, military expended materials can land on marine substrates. The Navy implements mitigation measures to reduce the potential for direct strike to shallow coral reefs from non-explosive practice munitions (Section 5.3.3.2, 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 3.3.3.2.1 (Impacts from Military Expended Materials) for marine habitats
- Section 3.4.3.3.3 (Impacts from Military Expended Materials) for marine mammals
- Section 3.5.3.3.3 (Impacts from Military Expended Materials) for sea turtles
- Section 3.6.3.3.3 (Impacts from Military Expended Materials) for birds
- Section 3.7.3.2.2 (Impacts from Military Expended Materials) for vegetation
- Section 3.8.3.3.2 (Impacts from Military Expended Materials) for invertebrates
- Section 3.9.3.3.2 (Impacts from Military Expended Materials) for fish

2. 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 (1) are not likely to destroy, cause the loss of, or injure sanctuary resources or qualities, and (2) 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 fish 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 destroying, causing the loss of, or injuring sanctuary resources, including marine mammals or sea turtles, is low. Furthermore, the Navy implements mitigation measures to reduce the potential for marine mammals and sea turtles to be exposed to sonar and other active acoustic sources throughout the entire AFTT Study Area (Section 5.3.1.2.1, Acoustic Stressors – Non-Impulsive Sound, and Section 5.3.2.1.1, Non-Impulsive Sound). 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 3.4.3.1.8 (Impacts from Sonar and Other Active Acoustic Sources) for marine mammals
  - Section 3.5.3.1.7 (Impacts from Sonar and Other Active Acoustic Sources) for sea turtles
  - Section 3.6.3.1.1 (Impacts from Sonar and Other Active Acoustic Sources) for birds
  - Section 3.8.3.1.1 (Impacts from Sonar and Other Non-Impulsive Acoustic Sources) for invertebrates
  - Section 3.9.3.1.2 (Impacts from Sonar and Other Non-Impulsive Acoustic Sources) for fish

- Electromagnetic devices

Electromagnetic devices are expected to cause only a minor and temporary behavioral reaction for marine mammals, 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 3.4.3.2.1 (Impacts from Electromagnetic Devices) and Section 3.4.3.3.2 (Impacts from Electromagnetic Devices) for marine mammals
  - Section 3.5.3.2.1 (Impacts from Electromagnetic Devices) for sea turtles

- Section 3.6.3.2.1 (Impacts from Electromagnetic Devices) for birds
- Section 3.8.3.2.1 (Impacts from Electromagnetic Devices) for invertebrates
- Section 3.9.3.2.1 (Impacts from Electromagnetic Devices) for fish

3. The following platforms, sources, or items that 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

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 does not propose to conduct any new activities that would cause significant impacts on sanctuary resources. Further, the Navy does not proposed to increase the level of existing activities within the sanctuary from what was previously considered at the time of sanctuary designation.

6.1.2.5.3 *Monitor* National Marine Sanctuary

The *Monitor* National Marine Sanctuary is located within in the Southeast U.S. Continental Shelf Large Marine Ecosystem off the coast of Cape Hatteras, North Carolina (Figure 6.1-2). 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. In addition to serving as a valuable national heritage and naval cultural specimen, the *Monitor* provides artificial reef habitat for numerous fish species, including black sea bass, oyster toadfish, and barracuda (National Marine Sanctuary Program 2008).

General regulations for the *Monitor* National Marine Sanctuary prohibit the following (15 C.F.R. § 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.

Permissible activities include free passage through the sanctuary. The *Monitor* National Marine Sanctuary does not have specific military exemptions from the applicable National Marine Sanctuary Program Regulations (15 C.F.R. §§ 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 National Marine Sanctuary Program Regulations, the Navy considered all proposed training and testing activities to determine which activities are likely to destroy, cause the loss of, or injure sanctuary resources or qualities. 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 likely to destroy, cause the loss of, or injure sanctuary resources or qualities:

   - Aircraft and Aerial Targets

   Aircraft and aerial targets would have no impact on the *Monitor* shipwreck.

   - Vessels and in-water devices (that do not make contact with seafloor)

   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.

   - Sonar and other active acoustic sources

   Sonar and other active acoustic sources would have no impact on the *Monitor* shipwreck.

   - Electromagnetic devices

   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

6.1.2.5.4 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 6.1-3). The geographical extent of the sanctuary encompasses an area of 2,900 nm^2, including waters surrounding the 126 mi. (203 km) 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. General sanctuary-wide regulations prohibit the following (15 C.F.R. § 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 C.F.R. 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 § 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 §§ 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 hardbottom 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 C.F.R. § 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 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 C.F.R. § 922.163(e)(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. 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(4) of the National Marine Sanctuary Act.

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/Environmental Impact Statement 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 National Marine Sanctuary Program Regulations, the Navy considered all proposed training and testing activities to determine which activities are likely to destroy, cause the loss of, or injure sanctuary resources or qualities in a manner significantly greater than was considered in the previous consultation under Section 304(d) of the National Marine Sanctuaries Act. The Navy concluded that the proposed activities could fall into the following three 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 were specifically exempted:

   - Aircraft and Aerial Targets

   Aircraft and aerial targets are expected to cause only a minor and temporary behavioral reaction due to noise for marine mammals, sea turtles, birds, or fish 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. The Navy implements standard operating procedures that require pilots of Navy aircraft to make every attempt to avoid birds in order to reduce the safety risk involved with a potential bird strike. For a more detailed discussion of potential impacts to these resources from the use of aircraft and aerial targets, see the following sections:

     - Section 3.4.3.1.14 (Impacts from Aircraft Noise) for marine mammals
     - Section 3.5.3.1.12 (Impacts from Vessel and Aircraft Noise) for sea turtles
     - Section 3.6.3.1.5 (Impacts from Aircraft and Vessel Noise) and Section 3.6.3.3.1 (Impacts from Aircraft and Aerial Targets) for birds, which includes discussion of applicable seabirds
     - Section 3.9.3.1.2 (Impacts from Sonar and Other Non-Impulsive Acoustic Sources) for fish

   - 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, sea turtles, seabirds, or fish 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. However, the Navy implements mitigation measures to reduce the potential for vessel strikes of marine mammals (Section 5.3.2.2, Physical Disturbance and Strikes, and Section 5.3.3.1, Marine

Mammal Habitats). In addition, all vessels use extreme caution and proceed at a "safe speed" so they can take proper and effective action to avoid a collision with any sighted object or disturbance, and can be stopped within a distance appropriate to the prevailing circumstances and conditions. 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 3.4.3.3.1 (Impacts from Vessels) and Section 3.4.3.3.2 (Impacts from In-Water Devices) for marine mammals
- Section 3.5.3.3.1 (Impacts from Vessels) and Section 3.5.3.3.2 (Impacts from In-Water Devices) for sea turtles
- Section 3.6.3.3.2 (Impacts from Vessels and In-Water Devices) for birds
- Section 3.7.3.2.1 (Impacts from Vessels and In-Water Devices) for vegetation
- Section 3.8.3.3.1 (Impacts from Vessels and In-Water Devices) for invertebrates
- Section 3.9.3.3.1 (Impacts from Vessels and In-Water Devices) for fish

- <u>Sonar and other active acoustic sources (including mine countermeasure research, acoustic research, submarine activities, sonobuoy testing, and special warfare activities)</u>

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 fish 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, the Navy implements mitigation measures to reduce the potential for marine mammals and sea turtles to be exposed to sonar and other active acoustic sources throughout the entire AFTT Study Area (Section 5.3.1.2.1, Acoustic Stressors – Non-Impulsive Sound, and Section 5.3.2.1.1, Non-Impulsive Sound). 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 3.4.3.1.8 (Impacts from Sonar and Other Active Acoustic Sources) for marine mammals
- Section 3.5.3.1.7 (Impacts from Sonar and Other Active Acoustic Sources) for sea turtles
- Section 3.6.3.1.1 (Impacts from Sonar and Other Active Acoustic Sources) for birds
- Section 3.8.3.1.1 (Impacts from Sonar and Other Non-Impulsive Acoustic Sources) for invertebrates
- Section 3.9.3.1.2 (Impacts from Sonar and Other Non-Impulsive Acoustic Sources) for fish

(2) 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 not likely to destroy, cause the loss of, or injure sanctuary resources:

- <u>Electromagnetic devices</u>

Electromagnetic devices are expected to cause only a minor and temporary behavioral reaction for marine mammals, 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 3.4.3.2.1 (Impacts from Electromagnetic Devices) and Section 3.4.3.3.2 (Impacts from Electromagnetic Devices) for marine mammals
- Section 3.5.3.2.1 (Impacts from Electromagnetic Devices) for sea turtles
- Section 3.6.3.2.1 (Impacts from Electromagnetic Devices) for birds
- Section 3.8.3.2.1 (Impacts from Electromagnetic Devices) for invertebrates
- Section 3.9.3.2.1 (Impacts from Electromagnetic Devices) for fish

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
   - 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 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 proposed to increase the level of existing activities within the sanctuary from what was previously considered at the time of sanctuary designation.

6.1.2.5.5 Flower Garden Banks National Marine Sanctuary

The Flower Garden Banks National Marine Sanctuary is located within in the northwestern portion of the Gulf of Mexico Large Marine Ecosystem, nearly 96 nm offshore of Texas and Louisiana (Figure 6.1-3). 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 (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 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 C.F.R. § 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 by 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 C.F.R. § 922.122(e)(1)). Activities that were carried out prior to the effective date of the sanctuary designation and identified in the original Final Environmental Impact Statement/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).

To ensure compliance with the National Marine Sanctuary Program Regulations, the Navy considered all proposed training and testing activities to determine which activities could have the potential for any significant adverse impacts on sanctuary resources or qualities. 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) are not likely to destroy, cause the loss of, or injure sanctuary resources or qualities, (2) do not have the potential for any significant adverse impacts on sanctuary resources or qualities, and (3) are carried out in a manner that minimizes any adverse impact on sanctuary resources and qualities:

   - Aircraft and Aerial Targets

   Aircraft and aerial targets are expected to cause only a minor and temporary behavioral reaction due to noise for marine mammals, sea turtles, birds, or fish 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. The Navy implements standard operating procedures that require pilots of Navy aircraft to make every attempt to avoid birds in order to reduce the safety risk involved with a potential bird strike. For a more detailed discussion of potential impacts to these resources from the use of aircraft and aerial targets, see the following sections:

     - Section 3.4.3.1.14 (Impacts from Aircraft Noise) for marine mammals
     - Section 3.5.3.1.12 (Impacts from Vessel and Aircraft Noise) for sea turtles
     - Section 3.6.3.1.5 (Impacts from Aircraft and Vessel Noise) and Section 3.6.3.3.1 (Impacts from Aircraft and Aerial Targets) for birds, which includes discussion of applicable seabirds
     - Section 3.9.3.1.2 (Impacts from Sonar and Other Non-Impulsive Acoustic Sources) for fish

   - 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, sea turtles, seabirds, or fish 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. However, the Navy implements mitigation measures to reduce the potential for vessel strikes of marine mammals (Section 5.3.2.2, Physical Disturbance and Strikes, and Section 5.3.3.1, Marine Mammal Habitats). In addition, all vessels use extreme caution and proceed at a "safe speed" so they can take proper and effective action to avoid a collision with any sighted object or disturbance, and can be stopped within a distance appropriate to the prevailing circumstances and conditions. 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 3.4.3.3.1 (Impacts from Vessels) and Section 3.4.3.3.2 (Impacts from In-Water Devices) for marine mammals
- Section 3.5.3.3.1 (Impacts from Vessels) and Section 3.5.3.3.2 (Impacts from In-Water Devices) for sea turtles
- Section 3.6.3.3.2 (Impacts from Vessels and In-Water Devices) for birds
- Section 3.7.3.2.1 (Impacts from Vessels and In-Water Devices) for vegetation
- Section 3.8.3.3.1 (Impacts from Vessels and In-Water Devices) for invertebrates
- Section 3.9.3.3.1 (Impacts from Vessels and In-Water Devices) for fish

▪ 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 invertebrates (cephalopods and crustaceans), diving birds, or fish 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, although marine mammals and sea turtles may occur within the Flower Garden Banks National Marine Sanctuary, there is no evidence to suggest that they would be concentrated in this area; therefore the likelihood of injury is low. In addition, the Navy implements mitigation measures to reduce the potential for marine mammals and sea turtles to be exposed to sonar and other active acoustic sources throughout the entire AFTT Study Area (Section 5.3.1.2.1, Acoustic Stressors – Non-Impulsive Sound, and Section 5.3.2.1.1, Non-Impulsive Sound). 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 3.4.3.1.8 (Impacts from Sonar and Other Active Acoustic Sources) for marine mammals
- Section 3.5.3.1.7 (Impacts from Sonar and Other Active Acoustic Sources) for sea turtles
- Section 3.6.3.1.1 (Impacts from Sonar and Other Active Acoustic Sources) for birds
- Section 3.8.3.1.1 (Impacts from Sonar and Other Non-Impulsive Acoustic Sources) for invertebrates
- Section 3.9.3.1.2 (Impacts from Sonar and Other Non-Impulsive Acoustic Sources) for fish

▪ Electromagnetic devices

Electromagnetic devices are expected to cause only a minor and temporary behavioral reaction for marine mammals, 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 3.4.3.2.1 (Impacts from Electromagnetic Devices) and Section 3.4.3.3.2 (Impacts from Electromagnetic Devices) for marine mammals
- Section 3.5.3.2.1 (Impacts from Electromagnetic Devices) for sea turtles
- Section 3.6.3.2.1 (Impacts from Electromagnetic Devices) for birds
- Section 3.8.3.2.1 (Impacts from Electromagnetic Devices) for invertebrates
- Section 3.9.3.2.1 (Impacts from Electromagnetic Devices) for fish

2. The following platforms, sources, or items that 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. 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 proposed to increase the level of existing activities within the sanctuary from what was previously considered at the time of sanctuary designation.

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 (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 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 will 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 Tactical Training Theater Assessment and Planning 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. § 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 would increase relative to the baseline, total fuel use would increase. Therefore, total fuel consumption would increase under the Proposed Action (Section 6.4), 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 CONSERVATION POTENTIAL OF ALTERNATIVES AND MITIGATION MEASURES

The federal government consumes two percent of the total U.S. energy share (Jean 2010). Of that two percent, the DoD consumes 93 percent. The Navy consumes one quarter of the total DoD share. The Navy consumes 1.2 billion to 1.6 billion gallons of fuel each year. The Navy expects a 25 percent increase in fuel consumption because of new ships coming into the fleet and the growth in mission areas (Jean 2010). The DoD has published a strategy to transform the way energy is consumed in military operations; the strategy sets the overall direction for operational energy security (Department of Defense 2011). Pursuant to the operational strategy report, the DoD published an implementation plan to integrate operational energy considerations and transformation into existing programs, processes, and institutions (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.

Increased 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. Details of fuel consumption by training and testing activities on an annual basis are set forth in the air quality emissions calculation spreadsheets available on the project website. Vessel fuel consumption is estimated to increase by 131 percent and 137 percent per year under Alternative 1 and Alternative 2, respectively, when compared to the No Action Alternative. Aircraft fuel consumption is estimated to increase by 42 percent and 45 percent per year under Alternative 1 and Alternative 2, respectively, when compared to the No Action Alternative. 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. Nevertheless, the demand for fuel consumption would increase from baseline levels, given the proposed increases in training and testing activities. The alternatives could result in a net cumulative reduction in the global energy (fuel) supply.

Energy requirements would be subject to any established energy conservation practices. The use of energy sources has been minimized wherever possible without compromising safety, training, or testing activities. No additional conservation measures related to direct energy consumption by the proposed activities are identified. The Navy's energy vision given in the Operational Energy Strategy report (Department of Defense 2011) 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 increase use of alternative energy and help conserve the world's resources for future generations. The Navy Climate Change Roadmap identifies actions the Environmental Readiness Division is taking to implement EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*. The Navy's Task Force Energy is responding to the Secretary of the Navy's Energy Goals through energy security initiatives that reduce the Navy's carbon footprint.

Two Navy programs—the Incentivized Energy Conservation Program and the Naval Sea Systems Command's Fleet Readiness, Research and Development Program—are helping the fleet conserve fuel via improved operating procedures and long-term initiatives. The Incentivized Energy Conservation Program encourages the operation of ships in the most efficient manner while conducting their mission and supporting the Secretary of the Navy's efforts to reduce total energy consumption on naval ships. 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 3.2, 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 plans to deploy by 2016 a green strike group (a "great green fleet") composed of nuclear vessels and ships powered by biofuel in local operations and with aircraft flying only with biofuels (Jean 2010).

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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 and Final EIS/OEIS. Comments received during the scoping and Draft EIS public comment periods can be found in Appendix E (Public Comments and Responses).

8.1 PROJECT WEB SITE

A public web site was established for this project: www.AFTTEIS.com. This web site address was published in the Notice of Intent to Prepare an Environmental Impact Statement and Overseas Environmental Impact Statement (Appendix B; Federal Register Notices). It was subsequently reprinted in newspaper advertisements, agency letters, and postcards for the Notice of Intent, Announcement of Public Scoping Meetings, Notice of Availability, and Notice of Public Meetings. The scoping meeting fact sheets, public meeting fact sheets, technical reports, and various other materials are available on the project web site 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 15 July 2010. This notice included a project description and scoping meeting dates and locations. The scoping period lasted 60 days, concluding on 14 September 2010. The scoping period provided a variety of opportunities for the public to comment on the scope of the EIS/OEIS.

8.2.1 PUBLIC SCOPING NOTIFICATION

The 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 Notice of Scoping Meeting letters were distributed on 15 July 2010 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 8-1 and an example of the letter can be found in Figure 8-1.

Table 8-1: 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 8-1: Entities that Received the Scoping Notification Letter (Continued)

Alabama	
State Elected Officials	**State Agencies**
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
Connecticut	
State Elected Officials	**State Agencies**
Office of the Governor Congressional Delegates	Connecticut Council on Environmental Quality Connecticut Department of Economic and Community Development Connecticut Department of Environmental Protection Connecticut Department of Public Health
Delaware	
State Elected Officials	**State Agencies**
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**
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
Georgia	
State Elected Officials	**State Agencies**
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
Louisiana	
State Elected Officials	**State Agencies**
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

Table 8-1: Entities that Received the Scoping Notification Letter (Continued)

Maine	
State Elected Officials	**State Agencies**
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
Maryland	
State Elected Officials	**State Agencies**
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
Massachusetts	
State Elected Officials	**State Agencies**
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 (Massport) Massachusetts Regional Planning Commission Massachusetts Water Resources Authority Merrimack Valley Planning Commission
Mississippi	
State Elected Officials	**State Agencies**
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
New Hampshire	
State Elected Officials	**State Agencies**
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

Table 8-1: Entities that Received the Scoping Notification Letter (Continued)

New Jersey	
State Elected Officials	**State Agencies**
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
New York	
State Elected Officials	**State Agencies**
Office of the Governor Congressional Delegates	New York State Department of Environmental Conservation
North Carolina	
State Elected Officials	**State Agencies**
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
Rhode Island	
State Elected Officials	**State Agencies**
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
South Carolina	
State Elected Officials	**State Agencies**
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

Table 8-1: Entities that Received the Scoping Notification Letter (Continued)

Texas	
State Elected Officials	**State Agencies**
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
Virginia	
State Elected Officials	**State Agencies**
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
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	

Table 8-1: Entities that Received the Scoping Notification Letter (Continued)

Regional (Continued)
Federal Agencies (Continued)
U.S. Coast Guard, District 9 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 5 U.S. Fish and Wildlife Service, Southeast Regional Office U.S. Geological Survey, Northeast Regional Office U.S. Geological Survey, South Central Regional Office U.S. Geological Survey, Southeast Regional Office
United States of America
Federal Agencies
Bureau of Ocean Energy, Management, Regulation, and Enforcement Marine Mammal Commission National Marine Fisheries Service, Headquarters National Marine Fisheries Service, Office of Protected Resources National Park Service U.S. Army Corps of Engineers, Headquarters U.S. Coast Guard, Office of Operating and Environmental Standards Division, Headquarters U.S. Department of Agriculture U.S. Department of Agriculture, Forest Service U.S. Department of Transportation, Maritime Administration, Office of Deepwater Ports and Offshore Activities U.S. Environmental Protection Agency U.S. Environmental Protection Agency, Office of Federal Activities U.S. Fish and Wildlife Service, Headquarters U.S. Geological Survey, Headquarters

DEPARTMENT OF THE NAVY
COMMANDER
U.S. FLEET FORCES COMMAND
1562 MITSCHER AVENUE SUITE 250
NORFOLK, VA 23551-2487

5090
Ser N4/N7/042
July 16, 2010

The Honorable Robert Riley
Governor of Alabama
State Capitol
600 Dexter Avenue
Montgomery, AL 36130

Dear Governor Riley:

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT/OVERSEAS ENVIRONMENTAL IMPACT STATEMENT FOR ATLANTIC FLEET TRAINING AND TESTING ACTIVITIES IN THE WESTERN NORTH ATLANTIC OCEAN, LOWER CHESAPEAKE BAY, AND THE GULF OF MEXICO

This letter is to inform you that the Department of the Navy is in the beginning stages of preparing an Environmental Impact Statement (EIS)/Overseas EIS (OEIS) for Atlantic Fleet Training and Testing (AFTT) activities in the Western North Atlantic Ocean, the lower Chesapeake Bay, 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.

The U.S. Navy's mission is to organize, train, equip, and maintain combat-ready naval forces capable of winning wars, deterring aggression, and maintaining freedom of the seas. This mission is mandated by federal law (Title 10 U.S. Code § 5062) which charges the Chief of Naval Operations (CNO) with the responsibility for ensuring the readiness of the nation's naval forces. The CNO meets that directive, in part, by establishing and executing training programs and ensuring naval forces have access to the ranges, operating areas, and airspace needed to develop and maintain skills.

The U.S. Navy's proposed action is to conduct military training and testing activities in the Western North Atlantic Ocean, the lower Chesapeake Bay and the Gulf of Mexico. Additional information on the U.S. Navy's proposed action and alternatives currently under consideration is enclosed.

In compliance with the National Environmental Policy Act of 1969, the U.S. Navy is holding open house public scoping meetings to support an early and open process for determining the scope of issues to be addressed and for identifying significant issues related to the proposed action. Scoping meetings will inform the public of the U.S. Navy's proposed action and allow community members an opportunity to comment. These comments will help identify potentially significant issues to be analyzed in the Draft EIS/OEIS.

Figure 8-1: Stakeholder Letter for the Notification of Scoping Meetings

5090
Ser N4/N7/042
July 16, 2010

Five open house meetings will be held to allow the public to provide input during the scoping process. Representatives from the U.S. Navy will be available to provide information and answer questions. Members of the public can arrive anytime between 4:00 p.m. and 8:00 p.m. There will be no formal presentation.

a. The public scoping meeting schedule is as follows:

Monday, August 23, 2010
Hynes Convention Center
900 Boylston Street
Boston, MA

Wednesday, August 25, 2010
Virginia Beach Convention Center
1000 19TH Street
Virginia Beach, VA

Thursday, August 26, 2010
Crystal Coast Civic Center
3505 Arendell Street
Morehead City, NC

Tuesday, August 31, 2010
Prime F. Osborn III
Convention Center
1000 Water Street
Jacksonville, FL

Wednesday, September 1, 2010
Gulf Coast Community College
5230 West Highway 98
Panama City, FL

b. Regardless of whether you participate in the public scoping meetings, you may send written comments to the following address:

Naval Facilities Engineering Command, Atlantic
ATTN: AFTT EIS/OEIS PM - Code EV22LL
6506 Hampton Boulevard
Norfolk, VA 23508-1278

You may also submit comments on the project website at: www.AFTTEIS.com. All comments must be postmarked or received by September 14, 2010 to be considered in the Draft EIS/OEIS. For additional information about the AFTT EIS/OEIS, please visit the project website.

Sincerely,

J. W. MURPHY
Deputy Chief of Staff
for Fleet Readiness and Training

Enclosure: (1) AFTT EIS/OEIS Project Description and Region Map

2

Figure 8-1: Stakeholder Letter for the Notification of Scoping Meetings (Continued)

8.2.1.2 Postcard Mailers

On 12 July 2010, postcards were mailed to 1,173 recipients on the project mailing list, including individuals, nonprofit organizations, and for-profit organizations. The postcards included the dates, locations, and times for the scoping meetings as well as the website for more information. An example of the postcard is shown in Figure 8-2.

Figure 8-2: Postcard Notification of Scoping Meetings

8.2.1.3 Press Releases

Press releases to announce the scoping meetings were distributed on 15 July 2010. The press release provided a description of the Proposed Action, address of the project website, duration of the comment period, and information on the public meetings. The release also provided information on the availability of the Navy Environmental Media Officer to meet with media in advance of the meetings. An example of the press release can be found in Figure 8-3.

MEDIA RELEASE

Public Affairs Office
Commander, U.S. Fleet Forces Command
1562 Mitscher Avenue, Suite 250
Norfolk, Va. 23511-2487
(757) 836-4429
Fax: (757) 836-3601

FOR IMMEDIATE RELEASE

PRESS RELEASE 25-10
19 August 2010

NAVY ASKS FOR PUBLIC INPUT AT OPEN HOUSE SCOPING MEETINGS

The Navy is holding public meetings to gather public input for the Atlantic Fleet Training and Testing (AFTT) Environmental Impact Statement (EIS/OEIS) which will evaluate potential environmental effects associated with training and testing activities in the Western North Atlantic Ocean, the lower Chesapeake Bay and the Gulf of Mexico.

The Navy initiated the scoping process to identify community concerns and issues for analysis in the EIS/OEIS. The Navy seeks the public's involvement and input which are a fundamental part of the Navy's EIS/OEIS development. As part of the public participation process, the Navy has planned meetings to obtain public input on the scope of the EIS.

The AFTT region covers approximately 2.6 million square nautical miles and encompasses the at-sea portions of Navy range complexes and research, development, testing and evaluation (RDT&E) ranges along the Atlantic and Gulf coasts of the United States. With the exception of the lower Chesapeake Bay, inland waters and land-based portions of these range complexes and RDT&E ranges are not a part of the AFTT region and will not be analyzed. Piers and channels at existing Navy ports, Navy shipyards and contractor shipyards in the AFTT region where Navy ship and submarine sonar maintenance and testing occur are also included in the AFTT EIS/OEIS. Please refer to attached map.

The public is encouraged to attend the Navy's open-house style scoping meetings for additional information about the proposed action and to provide written and oral comments on concerns to be addressed in the EIS/OEIS. The public may arrive any time during the open house. There will be no formal presentation; however, Navy experts will be on hand to answer questions about the proposed action and general inquiries about the NEPA process.

All written comments must be postmarked or received during the comment period to be considered in the Draft EIS/OEIS process. Written comments must be postmarked by Sept. 14 and mailed to:

Naval Facilities Engineering Command, Atlantic

ATTN: AFTT EIS/OEIS PM – Code EV22LL

6506 Hampton Boulevard

Norfolk, VA 23508-1278

Comments may also be submitted online at www.AFTTEIS.com or at one of five open house scoping meetings being held from 4 p.m. to 8 p.m. at the following locations:

Monday, August 23, 2010: Hynes Convention Center, 900 Boylston Street, Boston, Mass.

Wednesday, August 25, 2010: Virginia Beach Convention Center, 1000 19th Street, Virginia Beach, Va.

Thursday, August 26, 2010: Crystal Coast Civic Center, 3505 Arendell Street, Morehead City, N.C.

Tuesday, August 31, 2010: The Prime F. Osborn III Convention Center, 1000 Water Street, Jacksonville, Fla.

Wednesday, September 1, 2010: Gulf Coast Community College, 5230 West Highway 98, Panama City, Fla.

-USN-

NOTE: Media interested in attending any of the scoping meetings or in need of additional information should contact Ms. Julie Ann Ripley, Environmental Media Officer at U.S. Fleet Forces Command at (757) 836-4423 or (910) 381-8385. Media are asked to arrive one-half hour prior to the start of the meeting and are welcome to remain following any interviews.

Figure 8-3: Press Release Announcing Scoping Meetings for the Atlantic Fleet Training and Testing Environmental Impact Statement/Overseas Environmental Impact Statement

8.2.1.4 Newspaper Advertisements

To announce the scoping meetings, advertisements were placed in the listed newspapers in the following cities on the dates indicated in Table 8-2. An example of the advertisement is shown in Figure 8-4.

Table 8-2: Newspaper Announcements of Scoping Meetings

Portland, Maine *The Portland Press Herald* Friday, 16 July 2010 Monday, 16 August 2010 Friday, 20 August 2010 Saturday, 21 August 2010 Sunday, 22 August 2010	**New Bedford, Massachusetts** *The Standard Times* Friday, 16 July 2010 Friday, 13 August 2010 Friday, 20 August 2010 Saturday, 21 August 2010 Sunday, 22 August 2010	**Boston, Massachusetts** *Boston Herald* Friday, 16 July 2010 Friday, 13 August 2010 Friday, 20 August 2010 Saturday, 21 August 2010 Sunday, 22 August 2010
Newport, Rhode Island *Newport Daily News* Friday, 16 July 2010 Monday, 16 August 2010 Thursday, 19 August 2010 Friday, 20 August 2010 Saturday, 21 August 2010	**Salisbury, Maryland** *The Daily Times* Friday, 16 July 2010 Monday, 16 August 2010 Sunday, 22 August 2010 Monday, 23 August 2010 Tuesday, 24 August 2010	**Outer Banks, North Carolina** *Outer Banks Sentinel* Wednesday, 14 July 2010 Wednesday, 18 August 2010 Wednesday, 25 August 2010
Norfolk, Virginia *The Virginian-Pilot* Friday, 16 July 2010 Wednesday, 18 August 2010 Sunday, 22 August 2010 Monday, 23 August 2010 Tuesday, 24 August 2010	**Newport News, Virginia** *The Daily Press* Friday, 16 July 2010 Wednesday, 18 August 2010 Sunday, 22 August 2010 Monday, 23 August 2010 Tuesday, 24 August 2010	**Jacksonville, North Carolina** *Jacksonville Daily News* Friday, 16 July 2010 Sunday, 22 August 2010 Saturday, 28 August 2010 Sunday, 29 August 2010 Monday, 30 August 2010
Wilmington, North Carolina *Wilmington Star News* Friday, 16 July 2010 Thursday, 19 August 2010 Monday, 23 August 2010 Tuesday, 24 August 2010 Wednesday, 25 August 2010	**Charleston, South Carolina** *Charleston Post and Courier* Friday, 16 July 2010 Thursday, 19 August 2010 Monday, 23 August 2010 Tuesday, 24 August 2010 Wednesday, 25 August 2010	**Savannah, Georgia** *Savannah Morning News* Friday, 16 July 2010 Tuesday, 24 August 2010 Saturday, 28 August 2010 Sunday, 29 August 2010 Monday, 30 August 2010
Jacksonville, Florida *Florida Times Union* Friday, 16 July 2010 Tuesday, 24 August 2010 Saturday, 28 August 2010 Sunday, 29 August 2010 Monday, 30 August 2010	**Fort Lauderdale, Florida** *Florida Sun Sentinel* Friday, 16 July 2010 Monday, 23 August 2010 Saturday, 28 August 2010 Sunday, 29 August 2010 Monday, 30 August 2010	**Brevard, Florida** *Florida Today* Friday, 16 July 2010 Tuesday, 24 August 2010 Saturday, 28 August 2010 Sunday, 29 August 2010 Monday, 30 August 2010
Panama City, Florida *Panama City News Herald* Friday, 16 July 2010 Tuesday, 24 August 2010 Sunday, 29 August 2010 Monday, 30 August 2010 Tuesday, 31 August 2010	**Pensacola, Florida** *Pensacola News Journal* Friday, 16 July 2010 Sunday, 22 August 2010 Sunday, 29 August 2010 Monday, 30 August 2010 Tuesday, 31 August 2010	**New Orleans, Louisiana** *Times-Picayune* Friday, 16 July 2010 Monday, 23 August 2010 Sunday, 29 August 2010 Monday, 30 August 2010 Tuesday, 31 August 2010
Galveston, Texas *Galveston Daily News* Friday, 16 July 2010 Sunday, 22 August 2010 Sunday, 29 August 2010 Monday, 30 August 2010 Tuesday, 31 August 2010	**Corpus Christi, Texas** *Corpus Christi Caller Times** Friday, 16 July 2010 Monday, 23 August 2010 Sunday, 29 August 2010 Monday, 30 August 2010 Tuesday, 31 August 2010 ** Printed in English and Spanish*	

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) for training and testing activities conducted between 2014 and 2019. Careful consideration will be taken during analysis of potential environmental effects of the proposed action within the Navy's Atlantic Fleet Training and Testing Study Area.

The Navy wants your input!

You can participate in a variety of ways:

- Visit our website, www.AFTTEIS.com, to learn more and provide comment;
- Visit online links for more information on Navy training, testing and at-sea activities;
- Mail written comments to the address listed below; or
- Attend one of the five open house scoping meetings scheduled along the Atlantic coast and Gulf of Mexico.

Let the Navy know what environmental factors you want considered in the preparation of the EIS/OEIS.

PROPOSED ACTION:

The Navy's proposed action is to be able to conduct military training and testing activities in the Western North Atlantic Ocean and the Gulf of Mexico. The purpose of the proposed action is to achieve and maintain Fleet Readiness by conducting military training and testing activities in the Western North Atlantic Ocean and the Gulf of Mexico to meet the requirements of Title 10, and to attain compliance with applicable environmental authorizations, consultations, and other associated environmental requirements for those training and testing activities.

SUBMIT WRITTEN COMMENTS TO

Naval Facilities Engineering Command, Atlantic
Code: EV22LL (AFTT EIS/OEIS Project Manager)
6506 Hampton Boulevard
Norfolk, Virginia 23508-1278

FOR MORE INFORMATION

OR TO SUBMIT COMMENTS ON-LINE,
visit: **www.AFTTEIS.com**

All written comments must be received by September 14, 2010.

PUBLIC SCOPING MEETINGS

Five open house scoping meetings are scheduled along the Atlantic coast and Gulf of Mexico.

Boston, MA:
Aug. 23, 2010, 4 to 8 p.m.
Hynes Convention Center
900 Boylston Street
Boston, MA 02115

Virginia Beach, VA:
Aug. 25, 2010, 4 to 8 p.m.
Virginia Beach Convention Center
1000 19th Street
Virginia Beach, VA 23451

Morehead City, NC:
Aug. 26, 2010, 4 to 8 p.m.
Crystal Coast Civic Center
3505 Arendell Street
Morehead City, NC 28557

Jacksonville, FL:
Aug. 31, 2010, 4 to 8 p.m.
The Prime F. Osborn III Convention Center
1000 Water Street
Jacksonville, FL 32204

Panama City, FL:
Sept. 1, 2010, 4 to 8 p.m.
Gulf Coast Community College
5230 West Highway 98
Panama City, FL 32401

The Navy appreciates your input. If you are unable to attend a scoping meeting, there are still many opportunities to participate. Visit us at www.AFTTEIS.com to learn more.

Figure 8-4: Newspaper Announcement of Scoping Meeting

8.2.2 Scoping Meetings

Scoping meetings were held on 23, 25, 26, and 31 August 2010 and on 1 September 2010 in the cities of Boston, Massachusetts; Virginia Beach, Virginia; Morehead City, North Carolina; Jacksonville, Florida; and Panama City, Florida, respectively. 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.

8.3 Notification of Availability of the Draft Environmental Impact Statement/Overseas Environmental Impact Statement

8.3.1 Notification of Draft Environmental Impact Statement/Overseas Environmental Impact Statement and Public Meetings

The Navy made significant efforts to 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

Stakeholder letters were sent to federal agencies, state agencies, and some non-governmental organizations. 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. Figure 8-5 provides an example letter.

DEPARTMENT OF THE NAVY
COMMANDER
U.S. FLEET FORCES COMMAND
1562 MITSCHER AVENUE SUITE 250
NORFOLK, VA 23551-2487

5090
Ser N46/717
May 7, 2012

Refuge Manager, U.S. Fish & Wildlife Service, Tybee National Wildlife Refuge
Parkway Business Center
1000 Business Center Dr., Ste. 10
Savannah, GA 31405

Dear Sir or Madam :

SUBJECT: UNITED STATES NAVY'S ATLANTIC FLEET TRAINING AND TESTING DRAFT ENVIRONMENTAL IMPACT STATEMENT/OVERSEAS ENVIRONMENTAL IMPACT STATEMENT

This letter is to inform you that the Department of the Navy has prepared a Draft Environmental Impact Statement (EIS)/Overseas EIS (OEIS) for U.S. Navy training and testing activities conducted within the 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 off the east coast of North America and the Gulf of Mexico. The Study Area covers approximately 2.6 million square nautical miles of ocean area, and includes designated U.S. Navy operating areas and special use airspace (see enclosure).

The U.S. Navy's mission is to organize, train, equip, and maintain 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, primarily within existing range complexes, operating areas, and testing ranges along the east coast of the U.S., the Gulf of Mexico, pierside locations, port transit channels, and the lower Chesapeake Bay. 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

Figure 8-5: Stakeholder Letter for the Notification of the Draft and Final Environmental Impact Statement/Overseas Environmental Impact Statement

5090
Ser N46/717
May 7, 2012

Draft EIS/OEIS. All comments (oral or written) submitted during the 60-day public review period (May 11, 2012 to July 10, 2012) will become part of the public record on the Draft EIS/OEIS and will be addressed in the Final EIS/OEIS.

U.S. Navy representatives will be available during the open house 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:

Wednesday, May 30, 2012
Hotel Providence
139 Mathewson Street
Providence, RI 02903

Tuesday, June 5, 2012
The Prime F. Osborn III
Convention Center
1000 Water Street
Jacksonville, FL 32204

Wednesday, June 6, 2012
Hilton Garden Inn Panama City
1101 N. Highway 231
Panama City, FL 32405

Monday, June 11, 2012
Virginia Beach Convention Center
1000 19th Street
Virginia Beach, VA 23451

Tuesday, June 12, 2012
Hampton Inn and Suites Swansboro
215 Old Hammock Road
Swansboro, NC 28584

The Draft EIS/OEIS and additional information are available on the project website at: **www.AFTTEIS.com**. A CD-ROM of the Draft EIS/OEIS can also be sent on request.

Written comments may be submitted via the website or mailed to the following address:

Naval Facilities Engineering Command Atlantic
Attn Code EV22 (AFTT EIS Project Managers)
6506 Hampton Blvd
Norfolk, VA 23508-1278

Online comments may also be submitted on the project website at: **www.AFTTEIS.com**. All comments must be postmarked or received online by July 10, 2012, to be considered in the Final EIS/OEIS.

Sincerely,

G. L. Edwards

G. L. EDWARDS
Director
Environmental Readiness Division
By direction

Enclosure (1): U.S. Navy AFTT EIS/OEIS Project Description and Study Area Map

2

Figure 8-5: Stakeholder Letter for the Notification of the Draft and Final 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 along the east coast of the United States, the Gulf of Mexico, U.S. Navy pierside locations, port transit channels and the lower Chesapeake Bay. The proposed action also includes activities such as sonar maintenance and gunnery exercises conducted during ship transits, and which may occur outside U.S. Navy range complexes and testing ranges. The proposed action includes pierside sonar testing conducted as part of construction, overhaul, modernization, maintenance, and repair activities at shipyards and U.S. Navy piers.

The purpose of the proposed action is to conduct training and testing activities to ensure that the U.S. Navy accomplishes its mission to maintain, train, and equip combat-ready Naval Forces capable of winning wars, deterring aggression, and maintaining freedom of the seas.

No Action Alternative - Continues baseline training and testing activities, as defined by existing U.S. Navy environmental planning documents. The baseline testing activities also include those testing events that have historically occurred in the Study Area, and have been subject to previous analysis pursuant to National Environmental Policy Act (NEPA) and Executive Order 12114. The No Action Alternative is required by regulations as a baseline against which the impacts of the proposed action are compared.

Alternative 1 - Consists of the No Action Alternative plus the expansion of the Study Area boundaries and adjustments to the locations and tempos of training and testing activities from the baseline, as necessary to support current and planned U.S. Navy training and testing requirements. This alternative considers activities occurring on the range complexes and the testing ranges, as well as activities occurring within the Study Area outside of the range complexes and testing ranges; and mission requirements associated with force structure changes, including those resulting from the development, testing, and introduction of new platforms (ships and aircraft) and weapons systems into the fleet. Alternative 1 reflects the adjustment to the baseline necessary to support all current and proposed Navy at-sea training and testing activities through 2019.

Alternative 2 - Consists of Alternative 1 plus the establishment of new range capabilities and modifications of existing capabilities, adjustments to types and tempos of training and testing, and the establishment of additional locations to conduct activities within the Study Area.

Enclosure (1)

Figure 8-5: Stakeholder Letter for the Notification of the Draft and Final Environmental Impact Statement/Overseas Environmental Impact Statement (Continued)

Environmental Analysis:

Environmental effects that might result from the implementation of the U.S. Navy's proposed action or the alternatives under consideration have been analyzed in the Draft EIS/OEIS. Resources evaluated include sediments and water quality, air quality, marine habitats, marine mammals, sea turtles and other marine reptiles, birds, marine vegetation, marine invertebrates, fish, cultural resources, socioeconomic resources, and public health and safety.

AFTT Study Area:

The Study Area covers approximately 2.6 million square nautical miles and encompasses the at-sea portions of the range complexes and testing ranges shown on the map included here. The Study Area includes only the at-sea components of the range complexes and testing ranges, with the exception of the Narragansett Bay, lower Chesapeake Bay, St. Andrew Bay, and pierside locations. The remaining inland waters and land-based portions of the range complexes are not a part of the Study Area, and will be or already have been addressed under separate NEPA documentation. Navy pierside locations and port transit channels where sonar maintenance and testing occur, and bays and civilian ports where training occurs are also included in the Study Area as indicated on the map.

Enclosure (1)

Figure 8-5: Stakeholder Letter for the Notification of the Draft and Final Environmental Impact Statement/Overseas Environmental Impact Statement (Continued)

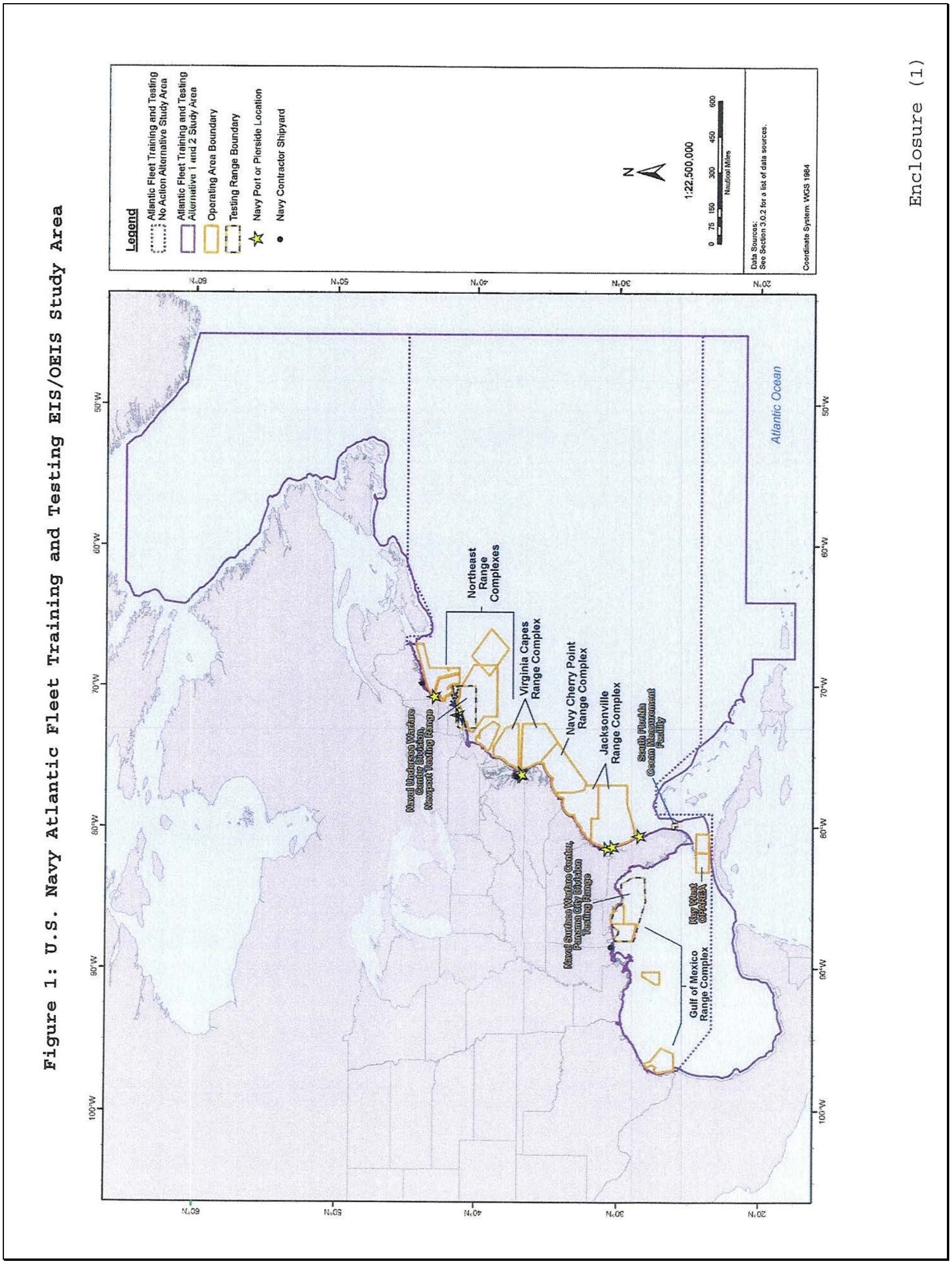

Figure 8-5: Stakeholder Letter for the Notification of the Draft and Final Environmental Impact Statement/Overseas Environmental Impact Statement (Continued)

8.3.1.2 Postcards

Postcards were sent to individuals, agencies, and organizations per request. 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 8-6.

Figure 8-6: Postcard for the Notification of Availability of the Draft Environmental Impact Statement/ Overseas Environmental Impact Statement and Announcement of Public Meetings

8.3.1.3 Press Releases

Press releases to announce the public meetings for the Draft EIS/OEIS were released on 29 May 2012. The press release provided a description of the Proposed Action, address of the project website, duration of the comment period, and information on the public meetings. The release also provided information on the availability of the Navy Environmental Media Officer to meet with media in advance of the meetings. An example of the press release can be found in Figure 8-7.

MEDIA ADVISORY

Public Affairs Office
Commander, U.S. Fleet Forces Command
1562 Mitscher Avenue, Suite 250
Norfolk, Va. 23551-2487
(757) 836-3600

FOR IMMEDIATE RELEASE

Press Release 38.1-12
29 May 2012

Navy to Hold Public Meetings on Atlantic Fleet Training and Testing Draft EIS/OEIS

NORFOLK, Va. — The U.S. Navy encourages the public to attend an open house public meeting to learn about and provide comments on the Draft Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) for Navy training and testing activities conducted in the Atlantic Fleet Training and Testing (AFTT) Study Area.

The AFTT region covers approximately 2.6 million square nautical miles and encompasses the at-sea portions of Navy range complexes and research, development, testing and evaluation ranges along the Atlantic and Gulf coasts of the United States.

Public meetings are being held to inform the public about the Navy's Proposed Action and to obtain comments on the Draft EIS/OEIS and the adequacy and accuracy of the analysis. The public meetings are scheduled from 4 p.m. to 8 p.m., and will be conducted as an open house information session. Navy representatives will be available to provide information about the Proposed Action and address questions related to the Draft EIS/OEIS. Locally the meeting will be held:

Wednesday, May 30, 2012: Hotel Providence, 139 Mathewson St., Providence, R.I.

Navy Invites Public Comment

The Navy is accepting comments throughout the 60-day comment period, from May 11, 2012 to July 10, 2012. All comments must be postmarked or received by **July 10, 2012**, to be considered in the Final EIS/OEIS. Written comments may be submitted via the project website at **www.AFTTEIS.com** or by mail to:

Naval Facilities Engineering Command Atlantic
Attn: Code EV22 (AFTT EIS Project Managers)
6506 Hampton Blvd.
Norfolk, VA 23508-1278

– more –

Figure 8-7: Press Release of Notification of Availability of the Draft Environmental Impact Statement/ Overseas Environmental Impact Statement and Announcement of Public Meetings

Copies of the Draft EIS/OEIS are available online or at one of following public libraries: Providence Public Library, 150 Empire Street, Providence, RI 02903; Public Library of New London, 63 Huntington St., New London, CT 06320; and Boston Public Library, Central Library, 700 Boylston St., Boston, MA 02116. Further details can be found at www.AFTTEIS.com.

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, the Gulf of Mexico, Navy pierside locations, port transit channels, Narragansett Bay, St. Andrew Bay and the lower Chesapeake Bay. The Proposed Action also includes activities such as sonar maintenance and gunnery exercises conducted concurrently with ship transits and which may occur outside Navy range complexes and testing ranges. The Proposed Action includes pierside sonar testing conducted as part of overhaul, modernization, maintenance and repair activities at shipyards and Navy piers, as well as new construction and overhaul at Navy-contracted shipbuilder locations.

The AFTT Draft EIS/OEIS updates the science and analyses needed to continue critical Navy training and testing in the Study Area. The Draft EIS/OEIS combines multiple previous studies into one, thereby incorporating expanded areas, and new science, platforms, and activities including ship shock testing on the east coast. Results from these studies show Navy activities continue to have negligible affects on marine mammal and turtle populations, including endangered species. Monitoring of Navy activities over the past several years supports these conclusions.

– USN –

MEDIA NOTE: A media availability will be held at the above location at 3:30 p.m. Wednesday, May 30. Media interested in attending or in need of additional information should contact Ms. Julie Ann Ripley, Environmental Media Officer at U.S. Fleet Forces Command at 910.381.8385 or julie.a.ripley@navy.mil.

Figure 8-7: Press Release of Notification of Availability of the Draft Environmental Impact Statement/ Overseas Environmental Impact Statement and Announcement of Public Meetings (Continued)

8.3.1.4 Newspaper Advertisements

To announce the Notification of Availability of the Draft EIS/OEIS and public meetings, advertisements were placed in the listed newspapers in the following cities on the dates indicated in Table 8-3. An example of the advertisement is shown in Figure 8-8.

Table 8-3: Newspaper Announcements of Notification of Availability of the Draft Environmental Impact Statement/Overseas Environmental Impact Statement and Announcement of Public Meetings

Portland, Maine *The Portland Press Herald* 11 and 29 May 2012	**New Bedford, Massachusetts** *The Standard Times* 11 and 29 May 2012	**Boston, Massachusetts** *Boston Herald* 11 and 29 May 2012
Providence, Rhode Island *Providence Journal* 11 and 29 May 2012	**Salisbury, Maryland** *The Daily Times* 11 May and 10 June 2012	**Outer Banks, North Carolina** *Outer Banks Sentinel* 16 May and 10 June 2012
Norfolk, Virginia *The Virginian-Pilot* 11 May and 10 June 2012	**Newport News, Virginia** *The Daily Press* 11 May and 10 June 2012	**Jacksonville, North Carolina** *Jacksonville Daily News* 11 May and 11 June 2012
Wilmington, North Carolina *Wilmington Star News* 11 May and 11 June 2012	**Charleston, South Carolina** *Charleston Post and Courier* 11 May and 4 June 2012	**Savannah, Georgia** *Savannah Morning News* 11 May and 4 June 2012
Jacksonville, Florida *Florida Times Union* 11 May and 4 June 2012	**Fort Lauderdale, Florida** *Florida Sun Sentinel* 11 May and 4 June 2012	**Brevard, Florida** *Florida Today* 11 May and 4 June 2012
Panama City, Florida *Panama City News Herald* 11 May and 5 June 2012	**Pensacola, Florida** *Pensacola News Journal* 11 May and 5 June 2012	**New Orleans, Louisiana** *Times-Picayune* 11 May and 5 June 2012
Galveston, Texas *Galveston Daily News* 11 May and 5 June 2012	**Corpus Christi, Texas** *Corpus Christi Caller Times** 11 May and 5 June 2012 ** Printed in English and Spanish*	

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) for training and testing activities conducted within the Navy's Atlantic Fleet Training and Testing Study Area. Public input is requested on the Proposed Action and alternatives, and 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 Mary D. Pretlow Anchor Branch Library (Norfolk) to view the Draft EIS/OEIS.

PROPOSED ACTION

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 and testing ranges along the east coast of the United States, the Gulf of Mexico, Navy pierside locations, port transit channels and the lower Chesapeake Bay. The purpose of the Proposed Action is to conduct training and testing activities to ensure that the Navy accomplishes its mission to maintain, train, and equip combat-ready U.S. naval forces.

SUBMIT WRITTEN COMMENTS TO

Naval Facilities Engineering Command Atlantic
Attention: Code EV22 (AFTT EIS Project Managers)
6506 Hampton Blvd.
Norfolk, VA 23508-1278

SUBMIT COMMENTS ONLINE AT **www.AFTTEIS.com**

All comments must be postmarked or received online by July 10, 2012, for consideration in the Final EIS/OEIS.

Open House Public Meetings
4 to 8 p.m.

Providence, RI:
May 30, 2012
Hotel Providence
139 Mathewson St.
Providence, RI 02903

Jacksonville, FL:
June 5, 2012
The Prime F. Osborn III Convention Center
1000 Water St.
Jacksonville, FL 32204

Panama City, FL:
June 6, 2012
Hilton Garden Inn Panama City
1101 N. Highway 231
Panama City, FL 32405

Virginia Beach, VA:
June 11, 2012
Virginia Beach Convention Center
1000 19th St.
Virginia Beach, VA 23451

Swansboro, NC:
June 12, 2012
Hampton Inn and Suites Swansboro
215 Old Hammock Road
Swansboro, NC 28584

For project details or information about accessing a copy of the Draft EIS/OEIS, visit www.AFTTEIS.com.
The Navy appreciates your input!

Figure 8-8: 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:

- 30 May 2012 in Providence, Rhode Island
- 5 June 2012 in Jacksonville, Florida
- 6 June 2012 in Panama City, Florida
- 11 June 2012 in Virginia Beach, Virginia
- 12 June 2012 in Swansboro, North Carolina

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 received a copy of the AFTT Draft and Final EIS/OEIS. 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 AFTT Draft and Final EIS/OEIS were delivered to the federal agencies listed in Table 8-4.

Table 8-4: Federal Agencies that Received the Draft and Final Environmental Impact Statement/ Overseas Environmental Impact Statement

FEDERAL AGENCIES	
National Marine Fisheries Service (NMFS)	
David Bernhart NOAA Fisheries Service Southeast Regional Office 263 13th Avenue South Saint Petersburg, FL 33701	David Gouviea NOAA Fisheries Service Northeast Regional Office 55 Great Republic Drive Gloucester, MA, 01930-2276
Ms. Helen M. Golde Acting Director, Office of Protected Resources National Marine Fisheries Service National Oceanic and Atmospheric Administration 1315 East-West Highway, SSMC3, Room 13821 Silver Spring, MD 20910-3282	
U.S. Environmental Protection Agency	
John Filippelli Environmental Review Coordinator U.S. Environmental Protection Agency, Region 2 290 Broadway New York, NY 10007-1866	Barbara Rudick Environmental Review Coordinator U.S. Environmental Protection Agency, Region 3 1650 Arch St. Philadelphia, PA 19103-2029
Susan Hedman Regional Administrator U.S. Environmental Protection Agency, Region 5 Ralph Metcalfe Federal Building 77 W. Jackson Blvd. Chicago, IL 60604	Tim Timmermann Environmental Review Coordinator U.S. Environmental Protection Agency, Region 1 5 Post Office Sq., Ste. 100 Boston, MA 02109
Heinz Mueller Chief, National Environmental Protection Act (NEPA) Office U.S. Environmental Protection Agency, Region 4 Atlanta Federal Center 61 Forsyth St., SW MC 9T25 Atlanta, GA 30303	

8.4.2 STATE ELECTED OFFICIALS

Electronic copies of the AFTT Draft and Final EIS/OEIS were delivered to the state governors listed in Table 8-5.

Table 8-5: State Agencies that Received the Draft and Final Environmental Impact Statement/ Overseas Environmental Impact Statement

STATE ELECTED OFFICIALS	
Alabama	The Honorable Robert Bentley Governor, State of Alabama Office of the Governor State Capitol, 600 Dexter Ave. Montgomery, AL 36130
Connecticut	The Honorable Dannel P. Malloy Governor, State of Connecticut Office of the Governor State Capitol, 210 Capitol Ave. Hartford, CT 06106
Delaware	The Honorable Jack Markell Governor, State of Delaware Office of the Governor Tatnall Building, William Penn Street, 2nd Fl. Dover, DE 19901
Florida	The Honorable Richard Scott Governor, State of Florida Office of the Governor 400 S. Monroe St. Tallahassee, FL 32399
Georgia	The Honorable Nathan Deal Governor, State of Georgia Office of the Governor 206 Washington Street Suite 203, State Capitol Atlanta, GA 30334
Louisiana	The Honorable Piyush "Bobby" Jindal Governor, State of Louisiana Office of the Governor PO Box 94004 Baton Rouge, LA 70804
Massachusetts	The Honorable Deval Patrick Governor, Commonwealth of Massachusetts Office of the Governor State House, Rm. 280 Boston, MA 02133
Maryland	The Honorable Martin O'Malley Governor, State of Maryland Office of the Governor 100 State Cir. Annapolis, MD 21401
Maine	The Honorable Paul LePage Governor, State of Maine Office of the Governor 1 State House Sta. Augusta, ME 04333
Mississippi	The Honorable Haley Barbour Governor, State of Mississippi Office of the Governor PO Box 139 Jackson, MS 39205
New Hampshire	The Honorable John Lynch Governor, State of New Hampshire Office of the Governor 107 North Main St. Concord, NH 03301
New Jersey	The Honorable Christopher Christie Governor, State of New Jersey Office of the Governor PO Box 001 Trenton, NJ 08625
New York	The Honorable Andrew M. Cuomo Governor, State of New York Office of the Governor NYS State Capitol Bldg. Albany, NY 12224
North Carolina	The Honorable Bev Perdue Governor, State of North Carolina Office of the Governor 20301 MSC Raleigh, NC 27699
Rhode Island	The Honorable Lincoln Chafee Governor, State of Rhode Island Office of the Governor 82 Smith St. Providence, RI 02903
South Carolina	The Honorable Nikki Haley Governor, State of South Carolina Office of the Governor 1205 Pendleton St. Columbia, SC 29201
Texas	The Honorable Rick Perry Governor, State of Texas Office of the Governor PO Box 12428 Austin, TX 78711
Virginia	The Honorable Robert McDonnell Governor, Commonwealth of Virginia Office of the Governor 1111 East Broad St., Patrick Henry Bldg. Fl. 3 Richmond, VA, 23219

8.4.3 State Clearinghouses or Agencies

Electronic copies of the AFTT Draft and Final EIS/OEIS were delivered to the state clearinghouses or agencies listed in Table 8-6. For states not having a clearinghouse, a copy of the EIS/OEIS was sent to the most relevant state agency.

Table 8-6: State Clearinghouses or Agencies that Received the Draft and Final Environmental Impact Statement/Overseas Environmental Impact Statement

STATE CLEARINGHOUSES, APPROPRIATE STATE AGENCY, AND OTHER STATE AGENCIES
Alabama
Lance R. LeFleur Director Alabama Department of Environmental Management PO Box 301463 Montgomery, AL 36130
Connecticut
Karl J. Wagener Executive Director Connecticut Council on Environmental Quality 79 Elm St. Hartford, CT 06106
Delaware
Cathy Wolfe Management Analyst Office of Management and Budget: Budget Development, Planning & Administration Haslet Armory, Fl. 3 122 William Penn St. Dover, DE 19901
Florida
Lauren Milligan Environmental Manager, Clearinghouse Coordination Florida State Clearinghouse: Florida Department of Environmental Protection 3900 Commonwealth Blvd., MS 47 Tallahassee, FL 32399
Georgia
Barbara Jackson Grants Administrator Georgia State Clearinghouse 270 Washington St., SW, Fl. 8 Atlanta, GA 30334
Louisiana
Peggy Hatch Secretary Louisiana Department of Environmental Quality PO Box 4301 Baton Rouge, LA 70821
Maine
Joel Johnson Economics and Demographics Program Maine State Planning Office 38 State House Station Augusta, ME 04333

Table 8-6: State Clearinghouses or Agencies that Received the Draft and Final Environmental Impact Statement/Overseas Environmental Impact Statement (Continued)

STATE CLEARINGHOUSES, APPROPRIATE STATE AGENCY, AND OTHER STATE AGENCIES
Maryland
Linda P. Janey, J.D. Assistant Secretary, Clearinghouse Communications Maryland State Clearinghouse for Intergovernmental Assistance 301 W. Preston St., Ste. 1101 Baltimore, MD 21201
Massachusetts
Edward M. Lambert, Jr. Commissioner Massachusetts Department of Conservation and Recreation 251 Causeway St., Ste. 900 Boston, MA 02114
Mississippi
Janet Riddell State Clearinghouse Representative Mississippi Department of Finance and Administration 1300 Woolfolk Bldg., Suite E 501 North West Street Jackson, MS 39201
North Carolina
Sheila Green Office of the Secretary, Administrative Assistant North Carolina Department of Administration: State Environmental Review Clearinghouse 1301 MSC Raleigh, NC 27699
New Hampshire
Joanne O. Morin Director New Hampshire Office of Energy and Planning 4 Chenell Drive Concord, NH 03301
New Jersey
Scott Brubaker Director New Jersey Department of Environmental Protection: Office of Permit Coordination and Environmental Review PO Box 423 Trenton, NJ 08625
New York
Joe Martens Commissioner New York State Department of Environmental Conservation 625 Broadway Albany, NY 12233
Rhode Island
Benny Bergantino Senior Planner Rhode Island State Division of Planning 1 Capitol Hill, 3rd Fl Providence, RI 02908

Table 8-6: State Clearinghouses or Agencies that Received the Draft and Final Environmental Impact Statement/Overseas Environmental Impact Statement (Continued)

STATE CLEARINGHOUSES, APPROPRIATE STATE AGENCY, AND OTHER STATE AGENCIES
South Carolina
Jean Ricard Grants Services and Special Projects South Carolina State Office of State Budget 1201 Main St., Ste. 715, Box 27 Columbia, SC 29201
Texas
Mark Vickery Executive Director Texas Commission on Environmental Quality PO Box 13087, MC 109 Austin, TX 78711
Virginia
Bill Hayden Public Affairs/Media Relations Virginia Department of Environmental Quality 629 E. Main St. PO Box 1105 Richmond, VA 23219
Virgin Islands
Ira Mills Director U.S. Virgin Islands Office of Management and Budget #41 Norre Gade Emancipation Garden Station, 2nd Fl St. Thomas, VI 00802

8.4.4 REPOSITORIES

Electronic copies of the AFTT Draft and Final EIS/OEIS were also delivered to the repositories listed in Table 8-7.

Table 8-7: Repositories that Received the Draft and Final Environmental Impact Statement/ Overseas Environmental Impact Statement

AFTT INFORMATION REPOSITORIES
Alabama
Ben May Main Library 701 Government St. Mobile, AL 36602
Connecticut
Public Library of New London 63 Huntington St. New London, CT 06320
Florida
Bay County Public Library 898 West 11th St. Panama City, FL 32401

Table 8-7: Repositories that Received the Draft and Final Environmental Impact Statement/ Overseas Environmental Impact Statement (Continued)

AFTT INFORMATION REPOSITORIES
Jacksonville Public Library, Main Library 303 N. Laura St. Jacksonville, FL 32202
Walton County Coastal Branch Library 437 Greenway Trail Santa Rosa Beach, FL 32459
West Florida Public Library, Main Library 200 W. Gregory St. Pensacola, FL 32502
West Florida Public Library, Southwest Branch 12248 Gulf Beach Hwy. Pensacola, FL 32507
West Palm Beach Public Library 411 Clematis Street West Palm Beach, FL 33401
Georgia
Camden County Public Library 1410 Hwy. 40 E. Kingsland, GA 31548
Louisiana
East Bank Regional Library 4747 W. Napoleon Ave. Metairie, LA 70001
New Orleans Public Library, Main Library 219 Loyola Ave. New Orleans, LA 70112
Maine
Portland Public Library 5 Monument Sq. Portland, ME 04101
Maryland
Anne Arundel County Public Library, Annapolis Area Branch 1410 West St. Annapolis, MD 21401
Massachusetts
Boston Public Library, Central Library 700 Boylston St. Boston, MA 02116
Mississippi
Meridian-Lauderdale County Public Library 2517 7th St. Meridian, MS 39301
North Carolina
Carteret County Public Library 1702 Live Oak St., Ste. 100 Beaufort, NC 28516

Table 8-7: Repositories that Received the Draft and Final Environmental Impact Statement/ Overseas Environmental Impact Statement (Continued)

AFTT INFORMATION REPOSITORIES
Hatteras Library 57709 Hwy. 12 Hatteras, NC 27943
Havelock-Craven County Public Library 301 Cunningham Blvd. Havelock, NC 28532
Kill Devil Hills Branch Library 400 Mustian St. Kill Devil Hills, NC 27948
New Hanover County Public Library 201 Chestnut St. Wilmington, NC 28401
Onslow County Public Library 58 Doris Ave. E. Jacksonville, NC 28540
Webb Memorial Library and Civic Center 812 Evans St. Morehead City, NC 28557
Rhode Island
Providence Public Library 150 Empire St. Providence, RI 02903
South Carolina
Charleston County Public Library, Main Library 68 Calhoun St. Charleston, SC 29401
Texas
Corpus Christi Public Library, La Retama Library 805 Comanche Corpus Christi, TX 78401
Houston Public Library 500 McKinney St. Houston, TX 77002
Southmost Branch Library 4320 Southmost Blvd. Brownsville, TX 78522
Virginia
Mary D. Pretlow Anchor Branch Library 111 W. Ocean View Ave. Norfolk, VA 23503

8.4.5 FEDERALLY-RECOGNIZED TRIBES

Electronic copies of the Draft and Final EIS/OEIS were sent to the federally-recognized tribes listed in Table 8-8.

Table 8-8: Federally-Recognized Tribes that Received the Draft and Final Environmental Impact Statement/Overseas Environmental Impact Statement

FEDERALLY-RECOGNIZED TRIBES
Alabama
Buford Rulin Chairman Poarch Band of Creek Indians of Alabama 5811 Jack Springs Rd. Atmore, AL 36502
Connecticut
Rodney Butler Chairman Mashantucket Pequot Tribe of Connecticut PO Box 3130 110 Pequot Trl. Mashantucket, CT 06338
Lynn Malerba Chairwoman Mohegan Indian Tribe of Connecticut 5 Crow Hill Rd. Uncasville, CT 06382
Florida
Colley Billie Chairman Miccosukee Tribe of Indians of Florida Mile Marker 70, U.S. 41 Tamiami Trl. Miami, FL 33144
James E. Billie Chairman Seminole Tribe of Florida 6300 Stirling Rd. Hollywood, FL 33024
Willard Steele Tribal Historic Preservation Officer Seminole Tribe of Florida's Tribal Historic Preservation Office 34735 West Boundary Rd. Clewiston, FL 33440
Louisiana
Earl Barbry Chairman Tunica-Biloxi Indian Tribe of Louisiana 151 Melacon Dr. Marksville, LA 71351
John Paul Darden Chairman Chitimacha Tribe of Louisiana PO Box 661 155 Chitimacha Loop Charenton, LA 70523

Table 8-8: Federally-Recognized Tribes that Received the Draft and Final Environmental Impact Statement/Overseas Environmental Impact Statement (Continued)

FEDERALLY-RECOGNIZED TRIBES
Louisiana (Cont'd)
Kevin Sickey Chairman Coushatta Tribe of Louisiana PO Box 818 Elton, LA 70532
Beverly Smith Chief Jena Band of Choctaw Indians, Louisiana PO Box 14 Jena, LA 71342
Maine
Reubin Cleaves Tribal Governor Passamaquoddy Tribe – Pleasant Point Reservation PO Box 343 Perry, ME 04667
Brenda Commander Tribal Chief Houlton Band of Maliseet Indians of Maine 88 Bell Road Littleton, ME 04730
Kirk Francis Tribal Chief Penobscot Tribe of Maine 12 Wabanaki Way Indian Island, ME 04468
Richard Getchell Tribal Chief Aroostook Band of Micmac Indians of Maine 7 Northern Rd. Presque Isle, ME 04769
Joseph Socobasin Tribal Governor Passamaquoddy Tribe – Indian Township Reservation PO Box 159 Indian Township, ME 04668
Massachusetts
Cheryl Andrews-Maltais Tribal Council Chairwoman Wampanoag Tribe of Gay Head of Massachusetts 20 Black Brook Rd. Aquinnah, MA 02535
Cedric Cromwell Chairman Mashpee Wampanoag Tribe, Massachusetts 483 Great Neck Rd., S Mashpee, MA 02649

Table 8-8: Federally-Recognized Tribes that Received the Draft and Final Environmental Impact Statement/Overseas Environmental Impact Statement (Continued)

FEDERALLY-RECOGNIZED TRIBES
Mississippi
Phyliss J. Anderson Tribal Chief Mississippi Band of Choctaw Indians, Mississippi 101 Industrial Rd. Choctaw, MS 39350
North Carolina
Michell Hicks Chief Eastern Band of Cherokee Indians of North Carolina PO Box 460 498 Tsali Blvd Cherokee, NC 28719
New York
Dyani Brown Chairperson Shinnecock Indian Nation P.O. Box 5006 Southampton, NY 11969
Mark Garrow Chief Saint Regis Mohawk Tribe, New York 412 State Rte. 37 Akwesasne, NY 13655
Ray Halbritter Nation Representative Oneida Nation of New York 2037 Dream Catcher Plz. Oneida, NY 13421
Clint Halftown Council of Chiefs Cayuga Nation of New York 2540 SR-89 Seneca Falls, NY 13148
Randy Hart Chief Saint Regis Mohawk Tribe, New York 412 State Rte. 37 Akwesasne, NY 13655
Leo Henry Chief Tuscarora Nation of New York 5616 Walmore Rd. Lewiston, NY 14092
Roger Hill Chief Tonawanda Band of Seneca Indians of New York 7027 Meadville Rd. Basom, NY 14013

Table 8-8: Federally-Recognized Tribes that Received the Draft and Final Environmental Impact Statement/Overseas Environmental Impact Statement (Continued)

FEDERALLY-RECOGNIZED TRIBES
Ron Lafrance, Jr. Chief Saint Regis Mohawk Tribe, New York 412 State Rte. 37 Akwesasne, NY 13655
Robert Porter President Seneca Nation of New York William Seneca Bldg. 12837 Rte. 438 Irving, NY 14081
Irving Powless, Jr. Chief Onondaga Nation of New York 102 W. Conklin Ave. Nedrow, NY 13120
Rhode Island
Matthew Thomas Chief Sachem Narragansett Indian Tribe of Rhode Island PO Box 268 Charlestown, RI 02813
South Carolina
Bill Harris Chief Catawba Indian Nation 996 Ave. of the Nations Rock Hill, SC 29730
Texas
Carlos Bullock Chairman Alabama-Coushatta Tribes of Texas 571 State Park Rd. 56 Livingston, TX 77351
Bryant J. Celestine Historical Preservation Officer Alabama-Coushatta Tribes of Texas Historic Preservation Office 571 State Park Road 56 Livingston, TX 77351
Juan Garza, Jr. Tribal Council Chairman Kickapoo Traditional Tribe of Texas HCR1 Box 9700 Eagle Pass, TX 78852
Frank Paiz Governor Ysleta del Sur Pueblo of Texas PO Box 17579 117 S. Old Pueblo Rd. El Paso, TX 79907

8.5 NOTIFICATION OF NATIONAL MARINE FISHERIES SERVICE PROPOSED RULE

Individuals who provided contact information during the public comment period for the Draft EIS/OEIS received notification of the NMFS Proposed Rule MMPA comment period (see Appendix E.3 [National Marine Fisheries Service Proposed Rule] for the Navy's response to comments). Notification was provided by letter or e-mail, based on the type of contact information provided. Private individuals who received the notification can be found in Table 8-9. Names of individuals appear as they were provided to the Navy. An example of the letter and e-mail notification can be found in Figure 8-9.

Table 8-9: Private Individuals Who Received Notification of National Marine Fisheries Service Proposed Rule

John Abbott	Anne Byers	Jennifer Dowdle
Elizabeth Abrams	Kristin Callis	Bonnie Duncan
Curt Albright	J. Capozzelli	Jahn Dussich
Wendy Alward	Bonnie Card	Sandy Dvorsky
Victoria Anderson	Heather Carpenter	Florence Eaise
Maru Angarita	Katherine Carrus	Christina Engert
Janet Arendacs	Debbie Carter	Maureen Engh
Steve Armstrong	Janice Chalifoux	Amy Evans
Stephen Augustine	Michael Chapman	Amanda Evans
Paula Avila	Carey Cherivtch	Judith Fairly
Donya Ayers-Bell	William and Martha Cherry	Lance Fanguy
Alexander Baggett	Linda Churchwell	Bruno Felix
Bill Baker	Christine Cina	Fabiana Fiesmann
Jessi Baker	Annette Cole	Barbara Fitzpatrick
Terry Baresh	Ron Cole	Flo Flowing
Melanie Barnet	Christine Coniglio	John Flynn
Mary Barnich	Vicki Cooper	Jack Foreman
Linn Barrett	Naila Costa	Kate Freeman
Marina Barry	Erica Cranden	Jarrett Gable
Gary Barton	Alexi Curington	Holly Gallo
Lawrence Baskett	Kim Daly	Lynn Garman
Jodi Bauter	Donald Dankert	Diana George
Amanda Beard-White	Mary P. Daoust	Julie Goldman
Eric Bernthal	Angelika Davis	Elizabeth Gray
Lisa Bigger	Kim Davis	Cynthia Greb
Blythe Bostock	Mary De Mars	Tamarleigh Grenfell
Denise Boulet	Elisse De Sio	Anke Groeber
Patricia Bourland	Margherite Desanto	Lance Groth
Kathy Braidhill	Fonda Dichiara	Valerie Haak
Thomas Brown	Henry Dipasquale	Barbara Haddad
Gina Brown	Steve Disch	Elizabeth Hale
Jennifer Brown	Amy Donovan	Elizabeth Hall
Jennifer Bruns	Katherine Dorothy	Melody Halligan
Serena Burnett	David Dow	Sharlene Harrison-Hinds

Table 8-9: Private Individuals Who Received Notification of National Marine Fisheries Service Proposed Rule (Continued)

Oriana Kalama
Leinaala Kalama-Dutro
Barbara Kann
Diane Kastel
Gunta Kaza
Teresa Keller
Greg Kelly
Kimberly Kelly
Angela Kemper
Natasha Keogh
Igor Khomyakov
Dawn Kirch
Paula Kislak, Dvm
William Knight
Ana Koopmans
Tracy Korhonen
Debbie Kozin
Janna Kruse
Marjorie Laird
Charlotte Landini
Dawn Lauer
Christopher Law
Marc Lemiere
Rita Lemkuil
Heidi Lett
Ted Lewis
Valerie Loe
Micah Loggie
Trina Lopatka
Joan Lorenz
Mary Lotts
Meredith Loughlin
Doris Maat
Melinda Macinnis
Doug Maesk
Karen Maish
L Makely
Ann Malone
Risa Mandell
Frank Mangione
Liz Marshall

Victoria Martin
Edith Maxey
Thomas Mazorlig
Vicki McCallister
Melinda McComb
Candice McConnell
Julie McDaniel
Ben McKinley
Kevin McMillen
Katherine McRory
Margit Meissner-Jackson
Susan Menconi
Kelly Micklo
Olof Minto
Melissa Minton
Joy Mitchem
Darlene Moak
Heather Mohan
Sandra Moreland
Douglas Morrison
Marica Mueller
Sue Murphy
Kris Murphy
Jill Nelson
Dawn Nelson
Maureen Newton
Joshua Normandin
Magda Novak
Samantha Novak
Carolyn O'brien
Yolanda Ochoa
Lynn O'Dowd
Eugene Okeeffe
Jill Olson
Jeanette Owen
Charlene Ozell
Rosemary Packard
Kathy Patterson
Jennifer Pechenik
Richard Pendarvis
Ruth Pennington

Laura Pereira
Virginia Perry
Rosalind Peterson
June Polasek
Leslie Porter
Rebecca Portman
Caroline Power
Jean Public
Cathy Pupo
Tracy Purcell
Sherry Ramsey
Rhonda Rance
Joanna Randazzo
Jill Ray
Nicholas Read
Leanne Redmon
Jedde Regante
Kathleen Reier
Valerie Retter
Renate Riffe
Sharon Riley
Cathy Ritacco
Suzanne Rivell
Tricia Rizzi
Frederick Rose
Julie Rosenwinkel
Christine Roth
Camille Rousseau
Barbara B. Ruge
James Ruhle
James Ruhle
Tamara Santelli
Francisco Santos
Marylou Schmidt
Maria Schultz
Dorene Schutz
Debra Scott
Robert Seat
Robert Seat
Deborah Seemayer-Lannotti
Evi Seidman

Table 8-9: Private Individuals Who Received Notification of National Marine Fisheries Service Proposed Rule (Continued)

Beverly Bernice Hartley Wilhite	Stephen Smith	Deborah S Van Damme
Sarah Hays	Elaine Smythe	Jean-François Van Den Broeck
Joyce Heid	Mark Songer	Holland Vandieren
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Randy Herz	Joyce Stanley	Rutily Vincent
Brittany Herz	Carol Stewart	Maria Vint
Heather Hintz	Kevon Storie	Kara Vlach-Lasher
Larry Hirsch	Amanda Stovall	Wendy Vogelgesang
B. Holden	Cristina Stoyle	Evelyn Vollmer
Barbara Holtz	Marguerite Strobel	Jennifer Vuillermet
John Hotvedt	Robin Sullivan	Diane Wacker
Kim Howell	Kathleen Summers	Cindy Wargo
Traci Hunt	Abbey Sutherland	John Webb
Sonia Hurt	Charles Swanson	Janet Weeks
Cheryl Huvard	Mindy Sweeny	Andrew Weinstein
Jenny Jackman	Sarah Swingle	Anita Welych
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Sam Jomes	Christina Tallman	Lisa Wilkerson
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Warren Senders	Geisa Teixeira	Denise Wilson
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John Shippey	Cecelia Theis	Jessica Woodward
Charlotte A. Shockley	Monika Thelen	Susan Woodward
Anna Sillanpaa	Terry Thompson	Thomas Wright
Sharon Silva	Pam Thompson	Tricia Wyse
Chevy Singh	Kevin Tierney	Patricia Yager Delagrange
Susan Siragusa-Ortman	Don Timmerman	Pasha Yushin
Kathleen Smith	Nan Towle	Cleia Zinser
C. Smith	Karen Valerio	

DEPARTMENT OF THE NAVY
COMMANDER
U.S. FLEET FORCES COMMAND
1562 MITSCHER AVENUE SUITE 250
NORFOLK, VA 23551-2487

5090
Ser N46/024
January 31, 2013

Atlantic Fleet Training and Testing
EIS/OEIS Interested Party

SUBJECT: NATIONAL MARINE FISHERIES SERVICE MARINE MAMMAL PROTECTION ACT PROPOSED RULE COMMENT PERIOD FOR ACTIVITIES ANALYZED IN THE UNITED STATES NAVY'S ATLANTIC FLEET TRAINING AND TESTING ENVIRONMENTAL IMPACT STATEMENT/OVERSEAS ENVIRONMENTAL IMPACT STATEMENT

The Navy is providing this update based on your interest in the Atlantic Fleet Training and Testing (AFTT) Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS). As part of the EIS process, the Navy has applied to the National Marine Fisheries Service (NMFS) for authorization to take marine mammals incidental to Navy training and testing activities in accordance with the Marine Mammal Protection Act (MMPA). On January 31, 2013, NMFS published in the Federal Register the MMPA Proposed Rule for public comment. The Proposed Rule can be found at: https://www.federalregister.gov/articles/2013/01/31/2013-01817/us-navy-training-and-testing-activities-in-the-atlantic-fleet-training-and-testing-study-area-takes.

Comments can be provided to NMFS by either of the following methods:

1. Electronic submissions: Submit all electronic public comments via the Federal eRulemaking Portal at: http://www.regulations.gov.

2. Hand delivery or mailing of paper, disk, or CD-ROM comments should be addressed to P. Michael Payne, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910-3225.

The quantified results of the marine mammal acoustic effects analysis presented in the Navy's Letter of Authorization application to NMFS differ from the quantified results presented

Figure 8-9: Notification of the National Marine Fisheries Service Proposed Rule

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January 31, 2013

in the AFTT Draft EIS/OEIS. Modifications to the requested take numbers outlined in the AFTT Draft EIS/OEIS are presented in the Proposed Rule and are a result of consultation with NMFS, as well as refinements to training and testing modeling inputs and minor changes to Navy training and testing as a result of emerging requirements. In consultation with NMFS, the Navy has made post-model adjustments to further refine the numerical analysis of acoustic effects so as to include animal avoidance of sound sources, avoidance of areas of activity before use of a sound source or explosive, and implementation of mitigation.

All comments received by NMFS on the Proposed Rule that address (1) refinement to the modeling inputs for training and testing; (2) emerging training and testing requirements; and (3) post-model quantification based on animal avoidance of sound sources and mitigation will be reviewed and addressed by the Navy in the AFTT Final EIS/OEIS.

For more information about the AFTT EIS/OEIS, please visit: http://aftteis.com/.

Sincerely,

G. L. Edwards

G. L. EDWARDS
Director
Environmental Readiness Division
By direction

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Figure 8-9: Notification of the National Marine Fisheries Service Proposed Rule (Continued)

[redacted]

From: Atlantic Fleet Training and Testing EIS/OEIS <do-not-reply=aftteis.com@mail179.us4.mcsv.net> on behalf of Atlantic Fleet Training and Testing EIS/OEIS <do-not-reply@aftteis.com>
Sent: Thursday, January 31, 2013 7:16 PM
To: [redacted]
Subject: Atlantic Fleet Training and Testing EIS/OEIS Proposed Rule Notification

Dear AFTT EIS/OEIS Interested Party,

The Navy is providing this update based on your interest in the Atlantic Fleet Training and Testing (AFTT) Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS). As part of the EIS process, the Navy has applied to the National Marine Fisheries Service (NMFS) for authorization to take marine mammals incidental to Navy training and testing activities in accordance with the Marine Mammal Protection Act (MMPA). On January 31, 2013, NMFS published in the Federal Register the MMPA Proposed Rule for public comment. The Proposed Rule can be found at:
http://aftteis.us6.list-manage.com/track/click?u=a15c167b01e85293585c92bce&id=0bc90ee5e7&e=11cdfa2dfd

Comments can be provided to NMFS by either of the following methods:

1. Electronic submissions: Submit all electronic public comments via the Federal eRulemaking Portal at: http://aftteis.us6.list-manage.com/track/click?u=a15c167b01e85293585c92bce&id=37fecdc4f7&e=11cdfa2dfd.

2. Hand delivery or mailing of paper, disk, or CD-ROM comments should be addressed to P. Michael Payne, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910-3225.

The quantified results of the marine mammal acoustic effects analysis presented in the Navy's Letter of Authorization application to NMFS differ from the quantified results presented in the AFTT Draft EIS/OEIS. Modifications to the requested take numbers outlined in the AFTT Draft EIS/OEIS are presented in the Proposed Rule and are a result of consultation with NMFS, as well as refinements to training and testing modeling inputs and minor changes to Navy training and testing as a result of emerging requirements. In consultation with NMFS, the Navy has made post-model adjustments to further refine the numerical analysis of acoustic effects so as to include animal avoidance of sound sources, avoidance of areas of activity before use of a sound source or explosive, and implementation of mitigation.

All comments received by NMFS on the Proposed Rule that address (1) refinement to the modeling inputs for training and testing; (2) emerging training and testing requirements; and (3) post-model quantification based on animal avoidance of sound sources and mitigation will be reviewed and addressed by the Navy in the AFTT Final EIS/OEIS.

For more information about the AFTT EIS/OEIS, please visit www.AFTTEIS.com http://aftteis.us6.list-manage.com/track/click?u=a15c167b01e85293585c92bce&id=5a14f68cb0&e=11cdfa2dfd

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You are receiving this email because you commented on the Draft AFTT EIS/OEIS on the aftteis.com website.

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Figure 8-9: Notification of the National Marine Fisheries Service Proposed Rule (Continued)