

APPENDIX G NON-ACOUSTIC IMPACTS SUPPORTING INFORMATION

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Draft
**Supplemental Environmental Impact Statement/
Overseas Environmental Impact Statement**
Atlantic Fleet Training and Testing

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G NON-ACOUSTIC IMPACTS SUPPORTING INFORMATION

G.1 HABITATS

The following topics were updated from the 2018 Final EIS/OEIS [Section 3.5](#) (Habitats):

- Distribution and abundance of benthic invertebrates along the depth gradient in the Study Area and relevance to the analysis. This information strengthens the reasoning presented in the 2018 Final EIS/OEIS for the diminished impact of military expended materials on the deepest regions of the Study Area.
- Expected burial rate of military expended materials. This information strengthens the reasoning presented in the 2018 Final EIS/OEIS for the diminished impact of military expended materials on shallow regions of the Study Area.

G.1.1 ENERGY STRESSORS

The background information for energy stressor effects on abiotic habitat in the Study Area as described in the 2018 Final EIS/OEIS ([Section 3.5.3.3](#)) has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS remains valid.

G.1.2 PHYSICAL DISTURBANCE AND STRIKE STRESSORS

The background information for vessels and in-water devices, seafloor devices, and pile driving substressor effects on abiotic habitat in the Study Area as described in the 2018 Final EIS/OEIS ([Section 3.5.3.4](#)) has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS remains valid.

G.1.2.1 Impacts from Military Expended Materials

The following information was updated from the 2018 Final EIS/OEIS:

Disturbance of the bottom from ship hulks may occur, but impairment of habitat function is not expected because the material is sunk in the abyssal zone where bottom organisms are generally small and sparsely populated (Rex et al., 2006); the deep ocean has a sparse supply of food items for sedentary deposit or filter feeders. The only densely populated areas in the deep ocean are around the occasional hydrothermal vent/cold seep.

The vast majority of heavy materials falling on soft or intermediate substrate areas (94 percent of the Study Area less than 2,500 meters [m] deep) would be completely buried after a year based on observations of mine shape burial under a variety of bottom conditions (Inman & Jenkins, 2002). On average, the data from Inman and Jenkins (2002) suggests most of the heavy materials (80 percent) would be buried after only six months. The seven-year footprint of the heavier military expended materials calculated in [Appendix I](#) (Military Expended Materials and Direct Strike Impact Analysis) is likely vastly overestimated as a persistent impact on the substrate surface. There is also a relationship between burial rate, impact on benthic organisms, and proximity to shore for heavy materials littering the seafloor. Recent research on marine debris presented in Section F.1.1.3 (General Threats) of [Appendix F](#) (Biological Resources Supplemental Information) reported a lengthy persistence of heavy materials in deep-water areas where the size and biomass of benthic organisms is very small and low, respectively (refer to Section F.3, Invertebrates, for supporting details). Conversely, the size and biomass of benthic organisms is typically high where the burial rates are also generally high (on the continental shelf), with some exceptions. Based on complex modeling of heavy munitions burial/mobility on the seafloor, the greatest potential for mobility occurs closest to dynamic shorelines with generally greater burial in deeper water and softer sediment on the continental shelf (Jenkins & Wever, 2007; Menzel et al., 2022).

G.1.3 ENTANGLEMENT STRESSORS

The background information for entanglement stressor effects on abiotic habitats in the Study Area as described in the 2018 Final EIS/OEIS ([Section 3.5.3.5](#)) has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS remains valid.

G.1.4 INGESTION STRESSORS

The background information for ingestion stressor effects on abiotic habitats in the Study Area as described in the 2018 Final EIS/OEIS ([Section 3.5.3.6](#)) has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS remains valid.

G.1.5 SECONDARY STRESSORS

The background information for secondary stressor effects on abiotic habitats in the Study Area as described in the 2018 Final EIS/OEIS ([Section 3.5.3.7](#)) has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS remains valid.

G.2 VEGETATION

The following topic was updated from the 2018 Final EIS/OEIS [Section 3.3](#) (Vegetation):

- Consideration for ingestion by some marine microalgae species. This information addresses an overlooked aspect of algal biology in the previous analysis for vegetation and stressors.

G.2.1 ENERGY STRESSORS

The background information for energy stressor effects on vegetation in the Study Area as described in the 2018 Final EIS/OEIS ([Section 3.3.3.3](#)) has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS remains valid.

G.2.2 PHYSICAL DISTURBANCE AND STRIKE STRESSORS

The background information for physical disturbance and strike stressor effects on vegetation in the Study Area as described in the 2018 Final EIS/OEIS ([Section 3.3.3.4](#)) has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS remains valid.

G.2.3 ENTANGLEMENT STRESSORS

The background information for entanglement stressor effects on vegetation in the Study Area as described in the 2018 Final EIS/OEIS ([Section 3.3.3.5](#)) has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS remains valid.

G.2.4 INGESTION STRESSORS

The following was updated from the 2018 Final EIS/OEIS ([Section 3.3.3.6](#)):

Ingestion stressors are not applicable to vegetation that uses photosynthesis vice ingestion to obtain necessary nutrients. However, there are numerous species of microscopic organisms (termed “mixotrophs”) that acquire energy from both the sun and by consuming other microorganisms (Stoecker et al., 2017). This includes many phytoplankton species that have profound impacts on marine planktonic ecosystems. Microscopic algae that ingest other algae (i.e., mixotrophic phytoplankton) would be unaffected by military readiness activities due to their vast populations, multiple methods of reproduction, fast growth, and resilience.

G.2.5 SECONDARY STRESSORS

The following was updated from the 2018 Final EIS/OEIS ([Section 3.3.3.7](#)):

Prey availability as an indirect link is not applicable to vegetation, as most species acquire energy directly from the sun and will not be analyzed further in this section. Whereas there are mixotrophic microalgae that eat other algae (refer to Section G.2.4, Ingestion Stressors, for details) and as such, the impact of phytoplankton eating other phytoplankton is not analyzed from the perspective of prey availability for vegetation or any other biological resource (e.g., fish eating other fish). Impacts from the Proposed Action Alternatives on vegetation availability as prey/forage are analyzed in the respective prey sections of other biological resources (e.g., [Section 3.5](#), Invertebrates, and [Section 3.6](#), Fishes).

G.3 INVERTEBRATES

The following topic was updated from the 2018 Final EIS/OEIS [Section 3.4](#) (Invertebrates):

- Population-level effect of microplastic consumption on marine invertebrates. The 2018 Final EIS/OEIS did not provide information on the population-level effect of microplastic consumption on marine invertebrates, for vital context.

G.3.1 ENERGY STRESSORS

The background information for energy stressor effects on invertebrates in the Study Area as described in the 2018 Final EIS/OEIS ([Section 3.4.3.3](#)) has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS remains valid.

G.3.2 PHYSICAL DISTURBANCE AND STRIKE STRESSORS

The background information for physical disturbance and strike stressor effects on invertebrates in the Study Area as described in the 2018 Final EIS/OEIS ([Section 3.4.3.4](#)) has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS remains valid.

G.3.3 ENTANGLEMENT STRESSORS

The background information for entanglement stressor effects on invertebrates in the Study Area as described in the 2018 Final EIS/OEIS ([Section 3.4.3.5](#)) has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS remains valid.

G.3.4 INGESTION STRESSORS

The following information was updated from the 2018 Final EIS/OEIS ([Section 3.4.3.6](#)):

Overall population-level effects of microplastic consumption across a broad range of species remain difficult to predict (Kaposi et al., 2014; Wright et al., 2013). The analysis in Hamilton et al. (2021) found mostly neutral effects of exposure to microplastics on marine invertebrates, with the most consistent effect being a reduction in consumption of natural prey among mostly filter feeders. There is also some evidence to suggest large quantities of microplastics end up the skeleton of reef-building corals, where it is effectively removed from circulation (Reichert et al., 2022).

G.3.5 SECONDARY STRESSORS

The background information for secondary stressor effects on invertebrates in the Study Area as described in the 2018 Final EIS/OEIS ([Section 3.4.3.7](#)) has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS remains valid.

G.4 FISHES

The following topics were updated from the 2018 Final EIS/OEIS [Section 3.6](#) (Fishes):

- Density of fishes located near the surface during the day in portions of some range complexes. This information strengthens the reasoning presented in the 2018 Final EIS/OEIS for the low potential for vessels, in-water devices, and military expended materials to strike fish near the surface.
- Vertical distribution of some sturgeon species in the water column. This information strengthens the reasoning presented in the 2018 Final EIS/OEIS for the generally low potential for vessels, in-water devices, and military expended materials to strike sturgeons near the surface, although the information confirms that at least some species occasionally surface or leap into the air.
- The effects of underwater vehicles on fish. This information strengthens the reasoning presented in the 2018 Final EIS/OEIS for the low potential for in-water devices to strike fish.
- Information on the potential for various fishes to ingest plastic particles, including particle size, fish feeding method, and proximity to plastic debris sources. This information provides additional context for evaluating potential impacts associated with ingestion of plastic military expended materials or fragments of these materials.
- Potential for bio-inspired slime to block a fish's throat if ingested. Bio-inspired slime is a new type of biodegradable polymer and was therefore not addressed in the 2018 Final EIS/OEIS.

G.4.1 ENERGY STRESSORS

The background information for energy stressor effects on fishes in the Study Area as described in the 2018 Final EIS/OEIS [Section 3.6.3.3](#) (Energy Stressors) has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS remains valid.

G.4.2 PHYSICAL DISTURBANCE AND STRIKE STRESSORS

The information in this section was updated from the 2018 Final EIS/OEIS [Section 3.6.3.4](#) (Physical Disturbance and Strike Stressors).

Information on fish abundance and density in the Study Area is provided in a study of marine species located near the surface within a potential offshore wind energy corridor off the U.S. Atlantic coast (Willmott et al., 2021). The results suggest a low daytime fish density and therefore low potential for strikes. Aerial surveys were conducted off the coasts of North Carolina and South Carolina, which coincides with all or portions of the Virginia Capes Range Complex, Navy Cherry Point Range Complex, and Charleston operating area (OPAREA), out to the 30-m depth contour. The combined daylight density of rays, sharks, and large bony fishes (e.g., tunas, mahi-mahi, billfish, and sunfish) observed near the surface, averaged over all survey seasons, was 1.66 animals per square kilometer (km²) (Willmott et al., 2021).

Some sturgeon species, particularly the Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), have been documented to be susceptible to vessel strikes. Although generally considered benthic species, sturgeons are occasionally found at the surface and some species are known to leap into the air, possibly to take air into the swim bladder to maintain neutral buoyancy (Dunbar, 2015; Thorn & Falgiani, 2013; Watanabe et al., 2008). An investigation of depth and vertical movements of Atlantic sturgeon and shortnose sturgeon (*A. brevirostrum*) in the Penobscot River, Maine, found that all fish remained at the bottom for extended time periods, sometimes for days (Dunbar, 2015). Out of hundreds of thousands of recorded data points, only 33 occurred at depths less than 0.5 m; these were assumed to be associated with surfacing behavior. Although a different species on a different continent, a study of seven Chinese sturgeons (*A. sinensis*) found two swim patterns and depth profiles, presumably related to buoyancy and swim bladder function (Watanabe et al., 2008). Four individuals actively swam in the water column at depths of 7 to 31 m, surfacing occasionally. Three fish spent nearly all their time (88 to

94 percent) on the bottom, also surfacing occasionally and immediately returning to depth. Surfacing behavior was suspected to be for the purpose of gulping air. A subsequent study involving Chinese sturgeons found that all individuals swam in an up-and-down pattern, moving between the bottom and approximately 5 m depth with individuals occasionally surfacing (Watanabe et al., 2012).

An investigation into the effects of various underwater vehicles documented no strikes on fishes (Campbell et al., 2021). Researchers observed only attraction or avoidance behaviors, depending on the general type of fish, the range between fish and device, speed of the device, and the habitat complexity. Fish were less reactive with increasing range (high end of the 2- to 50-m range) and decreasing speed (low end of the 0.5 to 3.5 knot range). Fish exhibiting attraction to the underwater vehicles were large pelagic and demersal (living on or near the seafloor) predators, including groupers. Smaller reef-associated species tended to hide when a fast-moving underwater vehicle was detected. In another experiment, an unmanned underwater vehicle traveling at three knots caused only localized school compression of Atlantic herring (*Clupea harengus*), a behavior that typically occurs on close approach of a potential predator (Fernandes et al., 2000). The vehicle was using navigational sonar and was powered by an electric motor. Generally, fishes may react behaviorally in response to noise produced by in-water devices. For example, one study designed to observe sound producing fish behavior found that remotely operated vehicle noise caused a startle response in various species (Rountree & Juanes, 2010). However, many of the unmanned underwater vehicles associated with proposed activities are battery powered and relatively quiet, and the potential for noise-related disturbance would therefore be low.

G.4.3 ENTANGLEMENT STRESSORS

The background information for entanglement stressor effects on fishes in the Study Area as described in the 2018 Final EIS/OEIS [Section 3.6.3.5](#) (Entanglement Stressors) has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS remains valid.

G.4.4 INGESTION STRESSORS

The following information in this section was updated from the 2018 Final EIS/OEIS [Section 3.6.3.6](#) (Ingestion Stressors).

Recent studies on the effects of debris ingestion by fish have focused on plastic debris, particularly microplastics (generally considered to be particles less than 5 millimeters [mm] in size). Plastic debris may block the digestive tract of fishes, and substances adsorbed to plastic (e.g., pesticides) may be absorbed by fishes that ingest them. The potential for ingestion seems to be mostly influenced by particle size (and potentially color) and feeding method. Overall, pelagic species that rely on vision for feeding are more likely to ingest non-food items (including plastic debris) than benthic species, most of which primarily use chemosensory cues such as taste (López-López et al., 2018; Roch et al., 2020). For example, Menezes et al. (2019) found a large (approximately 100 square centimeters [cm²]) plastic item in a mahi-mahi (*Coryphaena hippurus*) stomach. However, the results of one experiment suggest that at least some fishes that feed in the water column may visually distinguish between food and non-food items, even if they are of similar size. Juvenile spiny chromis (*Acanthochromis polyacanthus*), a plankton-feeding reef fish, consumed few plastic particles that were the same size as typical planktonic food, regardless of concentration in the water (Critchell & Hoogenboom, 2018). However, consumption increased substantially for plastic items that were one-fourth the size of natural food, presumably because the fish could not easily distinguish them visually as non-food items. The result suggests greater potential for ingestion and associated effects as plastic degrades into smaller particles.

In general, microplastic particles are more likely than larger plastic particles to occur in fishes because fishes may incidentally ingest them while foraging or drinking water, absorb them through the gills, or consume other animals that contain them. In a study involving pelagic and demersal fishes of the

Adriatic and Ionian seas, microplastic particles were found in 40 to 87 percent of fishes examined (depending on the location), while plastic particles greater than 1 mm in size were found in only about 2 to 26 percent of fish (Anastasopoulou et al., 2018). The proximity of fishes to anthropogenic debris sources and the degree of sampling difficulty may affect the reported incidences of plastic uptake. Markic et al. (2020) found that most plastic ingestion studies on wild marine fishes involved coastal benthic species and oceanic pelagic species, with few studies involving oceanic benthic or benthopelagic species. In one study, plastic debris was found in 48 percent of coastal demersal fishes located near a highly urbanized area, but in only about 2 percent of offshore pelagic and demersal fishes (Murphy et al., 2017). The overall effect of plastic ingestion on marine fish populations is unclear. The results of an extensive literature review on the effects of microplastics (less than 5 mm) on feeding, growth, reproduction, and survival indicate that feeding in larval and juvenile fish was negatively affected, but that no effects on adult fish were evident (Foley et al., 2018).

The potential for bio-inspired slime to block a fish's throat, if ingested soon after expenditure, could be greater than that of other biodegradable polymers because of the tacky nature of the material. However, the material would break down within hours to days after deployment, and the encounter rate in the Study Area would be low. The overall conclusions regarding the effects of biodegradable polymers would not change relative to those described in the 2018 Final EIS/OEIS [Section 3.6.3.6.2](#) (Impacts from Military Expended Materials – Other Than Munitions).

G.4.5 SECONDARY STRESSORS

The background information for secondary stressor effects on fishes in the Study Area as described in the 2018 Final EIS/OEIS [Section 3.6.3.7](#) (Secondary Stressors) has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS remains valid.

G.5 MARINE MAMMALS

Following a review of recent literature, information on potential impacts to marine mammals from proposed non-acoustic training and testing activities in the Study Area has not appreciably changed from what was presented the 2018 Final EIS/OEIS [Section 3.7](#) (Marine Mammals). As such, the information presented in the 2018 Final EIS/OEIS remains valid with exceptions provided below.

G.5.1 ENERGY STRESSORS

Following a review of recent literature, the background information for energy stressor effects on marine mammals in the Study Area as described in the 2018 Final EIS/OEIS [Section 3.7.3.3](#) (Energy Stressors) has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS remains valid.

G.5.2 PHYSICAL DISTURBANCE AND STRIKE STRESSORS

G.5.2.1 Impacts from Vessels and In-Water Devices

Surface vessels can be a source of acute and chronic disturbance for cetaceans (Au & Green, 2000; Bejder et al., 2006; Hewitt, 1985; Lusseau et al., 2009; Magalhães et al., 2002; Nowacek et al., 2007; Nowacek et al., 2004b; Richter et al., 2006; Richter et al., 2003; Schoeman et al., 2020; Watkins, 1986; Würsig & Richardson, 2009). Studies have established that cetaceans engage in avoidance behavior when surface vessels move toward them. Overall, strike avoidance success is dependent on a marine mammal's ability to identify and locate the vessel from its radiated sound and the animal's ability to maneuver away from the vessel in time.

Various research findings report that mysticetes have variable responses to vessels dependent on the context (Nowacek et al., 2004a; Richardson et al., 1995; Watkins, 1986). Similarly, odontocetes have also

demonstrated responses to vessels. One study showed that harbor porpoises in a net-pen displayed behavioral responses (increasing swim speed or repeated alternating surfacing and diving behaviors [i.e., porpoising]) to the high-frequency components of vessel noise at long ranges (more than 1,000 m) in shallow waters (Dyndo et al., 2015). These distances correspond to where radiated noise would be more likely to elicit the response, rather than physical presence of the vessel (Dyndo et al., 2015; Palka & Hammond, 2001). Conversely, another study demonstrated that physical vessel presence, and not just noise, was associated with a short-term reduction in foraging activity in bottlenose dolphins (Pirota et al., 2015). It is noteworthy that the dolphins associated with this report were exposed primarily to commercial and leisure boat traffic, not related to military vessel activities. Even repeated exposures from increasing vessel traffic in the same area resulting in increased responses to the disturbance may not be biologically significant. Mathematic modeling has predicted that bottlenose dolphin population dynamics would remain unchanged from a sixfold increase in vessel traffic (70 to 470 vessels per year) as dolphins are able to compensate for increased disturbance levels with little to no impacts on health and vital rates (New et al., 2013). Aside from the potential for an increased risk of strike addressed below, physical disturbance from vessel use is not expected to result in more than a short-term behavioral response.

Hauled-out pinnipeds are also disturbed when approached at close distance, although the research indicates this is somewhat context-dependent. For example, one study showed that harbor seals were disturbed by tourism-related vessels, small boats, and kayaks that stopped or lingered by haulout sites, but that the seals “do not pay attention to” passing vessels at closer distances (Johnson & Acevedo-Gutiérrez, 2007). Pinnipeds in the water generally appear less responsive (Richardson et al., 1995) than those at haulout sites. Walrus and polar bears have also appeared to be attracted to vessels at times (Harwood et al., 2005) and manatees have displayed vulnerabilities to vessel impacts (Nowacek et al., 2004b).

In some circumstances, marine mammals respond to vessels with the same behavioral repertoire and tactics they employ when they encounter predators. It is not clear what environmental cue or cues marine animals might respond to; they may include the sounds of water being displaced by the ships, the sounds of the ships’ engines, or a combination of environmental cues surface vessels produce while they transit. For example, in one study, North Atlantic right whales showed little overall reaction to the playback of sounds of approaching vessels, but they did respond to a novel sound by swimming strongly to the surface, which may increase their risk of strike (Nowacek et al., 2004a).

Vessel strikes from commercial, recreational, and Navy vessels are known to have resulted in serious injury and occasional fatalities to cetaceans (Abramson et al., 2011; Berman-Kowalewski et al., 2010; Calambokidis, 2012; Douglas et al., 2008; Laggner, 2009; Lammers et al., 2003; Van der Hoop et al., 2013; Van der Hoop et al., 2012). Reviews of the literature on ship strikes mainly involve strikes between commercial vessels and whales (Jensen & Silber, 2004; Laist et al., 2001). Juvenile whales of some species may be particularly vulnerable to vessel strikes due to their particular habitat use and surface foraging behavior in nearshore waters, where smaller vessel numbers are higher (Stepanuk et al., 2021).

Vessel speed, size, and mass are all important factors in determining potential impacts of a vessel strike to marine mammals (Conn & Silber, 2013; Gende et al., 2011; Silber et al., 2010; Vanderlaan & Taggart, 2007; Wiley et al., 2016). For large vessels, speed and angle of approach can influence the severity of a strike. Based on modeling conducted by Silber et al. (2010), researchers found that whales at the surface experienced impacts that increased in magnitude with the ship’s increasing speed. Another study found that there was a 3.4-fold decrease in close encounters between their research vessel and humpback whales when they traveled at speeds of 12.5 knots or less as opposed to greater than 12.5 knots (Currie et al., 2017).

G.5.2.1.1 Mysticetes

Vessel strikes have been documented for almost all of the mysticete species (Van der Hoop et al., 2012). This includes blue whales (Berman-Kowalewski et al., 2010; Calambokidis, 2012; Van Waerebeek et al., 2007), fin whales (Douglas et al., 2008; Van Waerebeek et al., 2007), North Atlantic right whales (Firestone, 2009; Fonnesbeck et al., 2008; Vanderlaan et al., 2009; Wiley et al., 2016) sei whales (Felix & Van Waerebeek, 2005; Van Waerebeek et al., 2007), Bryde's whales (Felix & Van Waerebeek, 2005; Van Waerebeek et al., 2007), minke whales (Van Waerebeek et al., 2007), humpback whales (Douglas et al., 2008; Lammers et al., 2003; Van Waerebeek et al., 2007), and bowhead whales (Halliday, 2020). Generally, mysticetes are larger than odontocetes and are not able to maneuver as well as odontocetes to avoid vessels. In addition, mysticetes do not typically aggregate in large groups and are therefore difficult to visually detect from the water surface.

Research suggests that the increasing noise in the ocean has made it difficult for whales to detect approaching vessels, which has indirectly raised the risk of vessel strike (Elvin & Taggart, 2008). For example, North Atlantic right whales are documented to show little overall reaction to the playback of sounds of approaching vessels, suggesting that some whales perform only a last-second flight response (Nowacek et al., 2004a). Some individuals may become habituated to low-frequency sounds from shipping and fail to respond to an approaching vessel (National Marine Fisheries Service, 2008). Because surface activity includes feeding, breeding, and resting, whales may be engaged in this activity and not notice an approaching vessel. Acoustic shadows may also form ahead of a moving vessel, where radiated ship noise levels approach or fall below ambient noise and therefore would be hard to detect if an animal is directly ahead of the ship (Gerstein et al., 2005).

On the other hand, the lack of an acoustic cue of vessel presence can be detrimental as well. One study documented multiple cases where humpback whales struck anchored or drifting vessels; in one case a humpback whale punched a 1.5-m hole through the hull of an anchored 22-m wooden sailboat, and another instance a humpback whale rammed a powered down 10-m fiberglass sailboat (Neilson et al., 2012). These results suggest that either the whales did not detect the vessel, or they intentionally struck it. In this study, vessel strikes to multiple cetacean species were included in the investigation; however, humpback whales were the only species that displayed this type of interaction with an unpowered vessel.

Another study found that 79 percent of reported strikes between sailing vessels and cetaceans occurred when the vessels were under sail, suggesting it may be difficult for whales to detect the faint sound of sailing vessels (Ritter, 2012). However, in some instances, avoidance behavior has been observed even after exposure to noise. A blue whale was observed in a near strike with a ship while the whale was tagged with a tag that collected depth information (Szesciorka et al., 2019). A 263-m container ship approached the whale while traveling at 11.3 knots and came within 93 m of the whale while the whale was at a depth of 67.5 m ascending from a foraging dive. The whale slowed its ascent and switched to a descent dive, surfacing three minutes later. This incident took place in Southern California, and prior to the near strike with the ship, the blue whale had been exposed to simulated mid-frequency (3 to 4 kHz) active sonar (Southall et al., 2019), which ended 62 minutes prior to the observation presented here.

Vessel strikes are a primary threat to North Atlantic right whale survival (Firestone, 2009; Fonnesbeck et al., 2008; Knowlton & Brown, 2007; Nowacek et al., 2004a; Vanderlaan et al., 2009). Studies of North Atlantic right whales tagged in April 2009 on the Stellwagen Bank feeding grounds found that they spent most of their time at a depth of 6.5 feet, which makes them less visible at the water's surface (Bocconcelli, 2009; Parks & Wiley, 2009). Between 2017 and 2023, 12 North Atlantic right whales were confirmed to have been killed by vessel strikes, and two more are considered to have serious injuries as the result of vessel strike (Koubrak et al., 2021; Kowarski et al., 2020; National Marine Fisheries Service, 2023).

Mysticetes that occur within the Study Area have varying patterns of occurrence and distribution, which overlap with areas where vessel use associated with military readiness activities would occur. For example, humpback whales that utilize the waters of the Chesapeake Bay near Naval Station Norfolk were found to spend considerable time (82 percent) engaged in foraging behavior at or near the mouth of the bay in close proximity to or directly in the shipping channel (Aschettino et al., 2020). Most of these animals were found to be juveniles, so there may be higher risk in younger animals who also have less experience maneuvering around vessels (Aschettino et al., 2020). Age-specific differences in habitat use compared to vessel density has been found in other areas within the Study Area as well (Stepanuk et al., 2021).

Risk of vessel strikes may increase depending on behavior. Increases in both nighttime foraging of some species and ship traffic overall contributes to increased risk of strike in some areas (Caruso et al., 2021). North Atlantic right whale mother-calf pairs spend 45 to 80 percent of their time surface resting or near-surface feeding during the first nine months of the calf's life (Cusano et al., 2019).

G.5.2.1.2 Odontocetes

Odontocetes that occur within the Study Area have varying patterns of occurrence and distribution, which overlap with areas where vessel use associated with military readiness activities would occur. Available literature suggests based on their smaller body size, maneuverability, larger group sizes, and hearing capabilities, odontocetes are not as likely to be struck by a vessel as mysticetes. When generally compared to mysticetes, odontocetes are more capable of physically avoiding a vessel strike, and, since some species occur in large groups, they are more easily seen when they are close to the water surface.

In general, odontocetes move quickly and seem to be less vulnerable to vessel strikes than other cetaceans; however, most small whale and dolphin species have at least occasionally suffered from vessel strikes, including killer whale (Van Waerebeek et al., 2007; Visser & Fertl, 2000), short-finned and long-finned pilot whales (Aguilar et al., 2000; Van Waerebeek et al., 2007), bottlenose dolphin (Bloom & Jager, 1994; Van Waerebeek et al., 2007; Wells & Scott, 1997), white-beaked dolphin (Van Waerebeek et al., 2007), short-beaked common dolphin (Van Waerebeek et al., 2007), spinner dolphin (Camargo & Bellini, 2007; Van Waerebeek et al., 2007), striped dolphin (Van Waerebeek et al., 2007), Atlantic spotted dolphin (Van Waerebeek et al., 2007), and pygmy sperm whales (*Kogia breviceps*) (Van Waerebeek et al., 2007). Beaked whales documented in vessel strikes include Arnoux's beaked whale (Van Waerebeek et al., 2007), goose-beaked whale (formerly Cuvier's beaked whale) (Aguilar et al., 2000; Van Waerebeek et al., 2007), and several species of *Mesoplodon* (Van Waerebeek et al., 2007).

However, evidence suggests that beaked whales may be able to hear the low-frequency sounds of large vessels and thus potentially avoid strike (Ketten, 1998). Sperm whales may be exceptionally vulnerable to vessel strikes as they spend extended periods of time "rafting" at the surface to restore oxygen levels within their tissues after deep dives (Jaquet & Whitehead, 1996; Watkins et al., 1999). Based on hearing capabilities and dive behavior, sperm whales may not be capable of successfully completing an escape maneuver, such as a dive, in the time available after perceiving a fast-moving vessel. This supports the suggestion that vessel speed is a critical parameter for sperm whale strike risks (Gannier & Marty, 2015). Data on vessel strikes of smaller cetaceans are generally scarce likely due, at least in part, to a reporting bias rather than strikes being less frequent (Schoeman et al., 2020).

G.5.2.1.3 Pinnipeds

Ship strikes were not reported as a global threat to pinniped populations by Kovacs et al. (2012). Pinnipeds in general appear to suffer fewer impacts from vessel strikes than do cetaceans or sirenians. This may be due, at least in part, to the time they spend on land resting and breeding, and their high maneuverability in the water. A review of seal stranding data from Cape Cod, Massachusetts, from 1999 to 2004 found that 622 pinniped strandings were recorded by the Cape Cod Stranding Network. Of these

622 strandings, 11 (approximately two percent) were found to be caused by boat strikes. Mortalities of pinnipeds (specifically harbor seals and gray seals) have initially been attributed to injuries sustained from ducted propellers on vessels such as workboats, tugs, and other support vessels (Bexton et al., 2012). However, further investigations have lead researchers to conclude that injuries that appeared to be the result of propellers were actually due to gray seal predation, cannibalism, and infanticide (Brownlow et al., 2016). Studies done in other areas have found similarly low trends—one study in the Salish Sea only found 27 instances of vessel strike out of 3,633 cases, with the majority of these cases found in pups (Olson et al., 2021).

G.5.2.1.4 Manatees

West Indian manatees respond to vessel movement via acoustic and possibly visual cues by moving away from the approaching vessel, increasing their swimming speed, and moving toward deeper water (Miksis-Olds et al., 2007; Nowacek et al., 2004b). The degree of the response varies with the individual manatee and may be more pronounced in deeper water where they are more easily able to locate the direction of the approaching vessel (Nowacek et al., 2004b). This disturbance is a temporary response to the approaching vessel. West Indian manatees have also been shown to seek out areas with a lower density of vessels (Buckingham et al., 1999). West Indian manatees exhibit a clear behavioral response to vessels within distances of 25 to 50 m (Nowacek et al., 2004b). Rycyk et al. (2018) found pronounced behavioral responses in tagged manatees when vessels passed within 10 m of the animal. While vessel speed did not have an impact on the occurrence, type, or number of behavioral changes observed in tagged manatees, results showed that manatees have more time to respond and changed their behavioral earlier when vessels approached slowly compared to vessels transiting on a plane at high speeds (approximately 20 miles per hour or greater) (Rycyk et al., 2018). Vessel traffic and recreation activities that disturb West Indian manatees may cause them to leave preferred habitats and may alter biologically important behaviors such as feeding, suckling, or resting (Haubold et al., 2006). Manatees use nearshore boat channels and open water fairways as migratory and travel corridors, but have been shown to use the nearshore channel more frequently (Cloyed et al., 2019).

In addition to disturbance, West Indian manatees are particularly susceptible to vessel strikes (both strikes with the hull and propeller strikes) because they hover near the surface of the water, move very slowly, and spend most of their time in inshore waters where vessel traffic tends to be more concentrated (Calleson & Frohlich, 2007; Gerstein, 2002; Haubold et al., 2006; Runge et al., 2007). Recent modeling suggests that approximately 96 percent of adults, 70 percent of subadults, and 34 percent of calves have watercraft-related scars (Bassett et al., 2020). Vessel strikes are the direct agent of most human-caused deaths to adult West Indian manatees (Rommel et al., 2007), accounting for approximately 21 percent of all manatee deaths from 1974 to 2016 (Bassett et al., 2020), and 15 percent of all manatee injuries recorded in Florida between 2008 and 2012 (U.S. Fish and Wildlife Service, 2014). An analysis of a five-year subset (2000 to 2004) of historical mortality data suggests that a disproportionate number of propeller-caused watercraft-related mortalities could be attributed to propeller diameters greater than or equal to 17 inches, suggesting that these were caused by watercraft greater than 40 feet (Rommel et al., 2007). The USFWS indicates that manatees are probably struck by smaller watercraft more often, but the likelihood of mortality is dependent on the force of strike, which is a factor of the speed and size of the vessel. Martin et al. (2015) found that the expected number of manatee and boat encounters in a given area increased with vessel speed and distance traveled by the boat. The findings in Rycyk et al. (2018) on manatee response time to slower vessels suggest strikes with slow-moving vessels are less likely to be lethal compared to high-speed vessels.

Not all strikes are fatal, as evidenced by the fact that most West Indian manatees in Florida bear scars from previous boat strikes (Rommel et al., 2007). In fact, the Manatee Individual Photo-identification

System identifies more than 3,000 Florida manatees by scar patterns mostly caused by boats, and most cataloged manatees have more than one scar pattern, indicative of multiple boat strikes (81 *Federal Register* 1000, January 8, 2016). Non-lethal injuries may reduce the breeding success of females (Haubold et al., 2006) and may lower a manatee's immune response (Halvorsen & Keith, 2008).

G.5.3 ENTANGLEMENT STRESSORS

Following a review of recent literature, the background information for entanglement stressor effects on marine mammals in the Study Area as described in the 2018 Final EIS/OEIS [Section 3.7.5.3](#) (Entanglement Stressors) has not appreciably changed. As such, the majority of the information presented in the 2018 Final EIS/OEIS remains valid, with the exception of updated text for Mysticetes provided below.

G.5.3.1 Mysticetes

Mysticete species with documented entanglement reports include humpback whales, North Atlantic right whales, Rice's whales, minke whales, and bowhead whales (Cassoff et al., 2011; National Oceanic and Atmospheric Administration Marine Debris Program, 2014). Aside from Rice's whales, the aforementioned species have records directly linking entanglement to marine debris as opposed to active fishing gear (Baulch & Perry, 2014; Laist, 1997). It has been estimated that a minimum of 52 percent and a maximum of 78 percent of whales have been non-lethally entangled in their lifetime in some populations (Neilson et al., 2009). In 2020, there were 25 reports of live entangled large whales along the east coast of the United States, and 33 in 2019 (National Marine Fisheries Service, 2022a, 2022b).

Entanglement of many large whales most often begins with rope being caught in its baleen plates. Based on feeding adaptations for mysticetes, oral entanglement may pose one of the greatest threats to survival, due to impaired foraging and possibly loss of function of the hydrostatic seal (formed when upper and lower lips come together and keep the mouth closed), requiring the whale to expend energy to actively keep the mouth closed during swimming (Cassoff et al., 2011). Impaired foraging could lead to deterioration of health, making the animal more susceptible to disease or eventual starvation over a long period of time, or chronic poor body condition which could result in suppressions to growth, age of sexual maturation and calving rates (Christiansen et al., 2020).

Compounding the issue, trailing lengths of rope or line may become wrapped around the animal's appendages as it struggles to free itself (Kozuck, 2003), limiting the animal's mobility and increasing drag. This reduced mobility can also reduce foraging success or even limit the animal's ability to surface. Notably, the single acute cause of entanglement mortalities has been associated with drowning from multiple body parts being entangled (Cassoff et al., 2011). Even if a whale is freed of an entanglement, the recovery time is estimated to be an average of 1.3 to 3 months (Moore et al., 2021; van der Hoop et al., 2017), extending the sub-lethal effects of an entanglement.

Common sources of entanglements for mysticetes include line and net fragments attached through the mouth or around the tail and flippers (National Oceanic and Atmospheric Administration Marine Debris Program, 2014). Rope diameter and breaking strengths may also determine an animal's ability to break free from entanglement. Increased rope strength has been found to be positively correlated with injury severity in right whales, but not for humpback whales (Knowlton et al., 2016). Minke whales were also found entangled in lower breaking strength ropes (10.47 kilonewtons [2,617 pound (lb.)-force]) than both humpback and right whales (17.13 and 19.30 kilonewtons [3,851 and 4,339 lb.-force], respectively) (Knowlton et al., 2016). These are significantly greater than the breaking strength of torpedo guidance wires

(maximum 42 lb.-force) as described in the 2018 Final EIS/OEIS [Section 3.0.3.3.5.1](#) (Wires and Cables). Entanglement would be more likely for materials with similar physical properties as those described above.

In the western North Atlantic, entanglement in fishing gear is a known cause of humpback whale injury and mortality, with all components of both pot and gillnet gear documented during 30 separate humpback whale entanglement events (Johnson et al., 2005). This study also found one entanglement event involving a vessel anchor line rather than fishing gear. Overall, between 6 and 26 percent (average 12 percent) of the population exhibits evidence of new entanglement injuries every year (Robbins, 2009), though the proportion of entanglements due to fishing gear is unknown. Available data indicate that males typically have more entanglement scars than females and may become entangled more frequently. Juvenile whales were found to have a higher rate of entanglement and be more at risk of serious injury and mortality when entangled than mature animals of the same species (Robbins, 2009, 2010).

Military expended material is expected to sink to the ocean floor. It is possible that marine mammals could encounter these items within the water column as they sink to the bottom. Less buoyant items that sink faster are not as likely to become entangled with a marine mammal compared to more buoyant materials that would sink slower to the floor. Mysticetes that occupy the water column or skim feed along the water surface would have to encounter a military expended material at the same time and location it is either expended or as it sinks.

Almost 3 percent of all right whale sightings between 1980 and 2016, and over half of all cataloged North Atlantic right whales (58 percent) have been observed with seafloor sediment on their bodies, which suggests these whales make frequent contact with the seafloor (Hamilton & Kraus, 2019). Mysticete species that feed near or at the bottom in the areas where activities are conducted that result in military expended materials could encounter items that have already sunk and, therefore, do not have to be present at the precise time when items are expended.

G.5.4 INGESTION STRESSORS

Following a review of recent literature, the background information for ingestion stressor effects on marine mammals in the Study Area as described in the 2018 Final EIS/OEIS [Section 3.7.3.6](#) (Ingestion Stressors) has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS remains valid.

G.5.5 SECONDARY STRESSORS

Following a review of recent literature, the background information for secondary stressor effects on marine mammals in the Study Area as described in the 2018 Final EIS/OEIS [Section 3.7.3.7](#) (Secondary Stressors) has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS remains valid.

G.6 REPTILES

The following information was updated since the 2018 Final EIS/OEIS ([Section 3.8](#), Reptiles).

- In 2024, Naval Undersea Warfare Center provided broad scale prediction models of in-water abundance, density, and distribution for four protected species of sea turtles (green, Kemp's ridley, leatherback, and loggerhead) along the United States east coast. The research is cited as (DiMatteo et al., 2024). In 2022, the National Oceanic and Atmospheric Administration Southeast Fisheries Science Center provided density spatial prediction models to estimate in-water abundance, density, and distribution for four protected species of sea turtles (as mentioned above) in the Gulf of Mexico. The research is cited as (Garrison et al., 2023; Rappucci et al., 2023). The models predict where animals may or may not occur within the study area

based on relationships with certain environmental and habitat variables. The abundance and density distribution predictions produced from these models show areas of low and higher density and abundance values based on these relationships.

- Green sea turtle density off the United States east coast was predicted to be highest in summer months (June to August) and lower in other months. Density was predicted to be high year-round near Georgia and Florida, as well as in the Florida Keys.
- Kemp's ridley sea turtle densities were predicted to be high year-round in Georgia and Florida. They were predicted to be in and around the Outer Banks in North Carolina during cooler months, moving northward in the late spring to occupy seasonal neritic habitats.
- Leatherback turtles were predicted throughout waters off the United States east coast, including offshore areas. Animals were predicted off Georgia and Florida year-round, with higher densities in warm months.
- Loggerhead sea turtle mean abundance off the United States east coast was predicted to be higher in cooler months (December to May) and lower in warmer months (June to November). Low but consistent density was predicted all months north of Long Island, New York and into the Gulf of Maine. Density off Florida was high year-round.
- Green sea turtle density was predicted to be highest in warm waters close to shore throughout the eastern and southeastern Gulf of Mexico. They are predicted to be in the northern region of the Gulf of Mexico year-round with density increasing from late spring to early fall.
- Kemp's ridley sea turtles were predicted to be throughout the Gulf of Mexico during all seasons, with higher densities off the west coast of Florida and Louisiana, particularly during winter months. Their predicted densities tended to be highest at intermediate water depths and declined quickly in waters greater than 15 m depth.
- Leatherback sea turtles were predicted to be present during all seasons. In the winter and spring, they were predicted to be east of the mouth of the Mississippi River. Higher density was predicted in the middle of the continental shelf and offshore waters deeper than 50 m.
- Loggerhead sea turtle densities were predicted to be highest in the eastern Northern Gulf of Mexico and in nearshore waters of the central Northern Gulf of Mexico. The highest overall densities were predicted in January through April and higher density areas were found off Louisiana and the Florida panhandle south to the Florida Keys.
- Sea turtle dive behavior and foraging depths from updated literature were incorporated into the section discussing physical disturbances, particularly vessel strike stressors, and entanglement stressors.
- Updated literature has been added to secondary stressors with respect to average daily intake of harsh metals increasing in sea turtle populations.
- Updated literature on anthropogenic debris found in reptiles has been incorporated into the ingestion stressors section.
- Bathythermographs are added to the discussion as a potential entanglement stressor for marine reptiles in the Study Area. Added information to the Wires and Cables section.

G.6.1 ENERGY STRESSORS

Disturbance from energy stressors that may impact reptiles consists of: (1) in-water electromagnetic devices and (2) high-energy lasers. Because energy stressors would not occur in habitats used by the American crocodile (*Crocodylus acutus*), the impacts that may potentially occur from energy stressors are limited to sea turtles, American alligators, and diamondback terrapins.

The background information for high energy stressor effects on terrapins and alligators in the Study Area as described in the 2018 Final EIS/OEIS [Section 3.8.3.3](#) (Energy Stressors) has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS remains valid. Below is a brief summary of background context to support updated literature provided regarding energy stressor impacts to sea turtles in the Study Area.

G.6.1.1 Impacts from In-Water Electromagnetic Devices

Several different electromagnetic devices are used during training and testing activities. A discussion of the characteristics of energy introduced into the water through training and testing activities and the relative magnitude and location of these activities is presented in [Section 3.0.3.3.3](#) (Energy Stressors) of the 2018 Final EIS/OEIS. Table 3.0-6 (Number and Location of Activities Using In-Water Electromagnetic Devices) shows the number and location of proposed activities that include energy stressors that are considered in this Supplemental EIS/OEIS and the equivalent information from the 2018 Final EIS/OEIS for comparison.

The devices producing an electromagnetic field are towed or unmanned mine countermeasure systems. Studies on behavioral responses to magnetic fields have been conducted on green and loggerhead sea turtles. Loggerheads were found to be sensitive to field intensities ranging from 0.005 to 4,000 microteslas, and green sea turtles were found to be sensitive to field intensities from 29.3 to 200 microteslas (Bureau of Ocean Energy Management, 2011). Because these data are the best available information, this analysis assumes that the responses would be similar for other sea turtle species.

Sea turtles use geomagnetic fields to navigate at sea, and therefore changes in those fields could impact their movement patterns (Lohmann & Lohmann, 1996; Lohmann et al., 1997). Sea turtles in all life stages orient to Earth's magnetic field to position themselves in oceanic currents, and directional swimming presumably aided by magnetic orientation has been shown to occur in some sea turtles (Christiansen et al., 2016; Putman & Mansfield, 2015). This helps them locate seasonal feeding and breeding grounds and return to their nesting sites (Lohmann & Lohmann, 1996; Lohmann et al., 1997). Evidence has shown that natal homing is accomplished by sea turtles in two steps: (1) long-distance movements through the open ocean into the vicinity of the natal area which is likely guided by magnetic navigation and geomagnetic imprinting (Brothers & Lohmann, 2015; Lohmann & Lohmann, 2019; Putman et al., 2015) and (2) localization of a suitable site for reproduction. Sea turtles might imprint on a single element of the geomagnetic field (either inclination angle or intensity) at the location to which they will return to nest. To locate the area later in life, the sea turtle would need only to find the coastline, and then swim north or south along it to reach the target location (Lohmann & Lohmann, 2019). Studies confirmed that nesting females locate their natal beaches by seeking out specific magnetic signatures (Brothers & Lohmann, 2018). A study on loggerhead sea turtles found that sea turtles at nesting beaches with similar magnetic fields were genetically similar compared to nesting populations at beaches marked by larger differences in magnetic fields and therefore had greater genetic differences (Brothers & Lohmann, 2018).

As stated in [Section 3.0.3.3.3](#) (Energy Stressors) of the 2018 Final EIS/OEIS, the static magnetic fields generated by electromagnetic devices used in training and testing activities are of relatively minute

strength. The maximum strength of the magnetic field is approximately 2,300 microteslas, with the strength of the field decreasing further from the device. At a distance of 4 m from the source of a 2,300-microtesla magnetic field, the strength of the field is approximately 50 microteslas, which is within the range of Earth's magnetic field (25 to 65 microteslas). At 8 m, the strength of the field is approximately 40 percent of Earth's magnetic field, and only 10 percent at 24 m away from a 2,300 microtesla magnetic field at the source. At a distance of 200 m the magnetic field would be approximately 0.2 microteslas (U.S. Department of the Navy, 2005), which is less than one percent of the strength of Earth's magnetic field. This is likely within the range of detection for sea turtle species, but at the lower end of the sensitivity range.

G.6.1.2 Impacts from High-Energy Lasers

High-energy laser weapons training and testing involves the use of up to 30 kilowatts of directed energy as a weapon against small surface vessels and airborne targets (see Table 3.0-7, Number and Location of Activities Using High-Energy Lasers). These weapons systems are deployed from surface ships and helicopters to create small but critical failures in potential targets and used at short ranges from the target.

This section analyzes the potential impacts of high-energy lasers on sea turtles. As discussed in 2018 Final EIS/OEIS [Section 3.0.3.3.3](#) (Energy Stressors), high-energy laser weapons are designed to disable surface targets, rendering them immobile. High-energy lasers would only be used in open-ocean areas for training and testing activities; therefore, crocodilian and terrapin species are not included in the analysis for potential impacts from high-energy lasers because they would not be in areas where high-energy lasers would be used.

The primary concern for high-energy weapons training and testing is the potential for a sea turtle to be struck by a high-energy laser beam at or near the water's surface, which could result in injury or death from traumatic burns from the beam. The Navy conducted a strike analysis using sea turtle species with the highest average month density in the training and testing areas of interest which is the green sea turtle within the Virginia Capes Range Complex and the loggerhead sea turtle within the Jacksonville Range Complex.

The only potential effect on sea turtles from the use of high-energy lasers is direct exposure to laser light incident on the water's surface at the time a sea turtle is at or near the water's surface, and for the exposure to cause injury. A sea turtle could only be exposed if a laser beam missed the intended target and inadvertently struck a nearby sea turtle. Should the laser strike the sea surface, individual sea turtles at or near the surface could be exposed. The potential for exposure to a high energy laser beam decreases as the water depth increases. Because laser platforms are typically helicopters and ships, sea turtles at sea would likely move away or submerge in response to other stressors, such as ship or aircraft noise, although some sea turtles would not exhibit a response to an oncoming vessel or aircraft, increasing the risk of contact with the laser beam. Per the Navy's strike analysis, the probability of a strike from a high energy laser to green sea turtle in the Virginia Capes Range Complex and for loggerheads in the Jacksonville Range Complex is a probability of less than 1 percent (see [Appendix I](#), Military Expended Materials and Direct Strike Impact Analysis). The probability analysis does not take into account that high-energy laser systems used in military readiness activities automatically shut down when target-lock is lost; meaning that if a high-energy laser beam aimed at a small boat on the surface, either from aircraft or surface vessel, moves off the target, the system ceases projecting laser light, preventing any energy from striking the water or a nearby sea turtle.

G.6.2 PHYSICAL DISTURBANCE AND STRIKE STRESSORS

The physical disturbance and strike stressors that may impact reptiles consist of (1) vessels and in-water devices; (2) military expended materials, including non-explosive practice munitions and fragments from

high-explosive munitions; and (3) seafloor devices. Detailed information describing these stressors can be found in [Section 3.0.3.3.4](#) (Physical Disturbance and Strike Stressors) of the 2018 Final EIS/OEIS. While the majority of information is the same as the 2018 Final EIS/OEIS, there are several updates to this stressor contained in Section 3.0.3.3.4 and Tables 3.0-9 (Number and Location of Activities Including Vessels) and 3.0-10 (Number and Location of Activities Including In-Water Devices) in this Supplemental EIS/OEIS. Following a review of recent literature, the background information for effects of these stressors on reptiles in the Study Area has not appreciably changed, as described in the 2018 Final EIS/OEIS [Section 3.8.3.4](#) (Physical Disturbance and Strike Stressors). With the exception of vessel strike stressor effects to sea turtles, all physical disturbance and strike stressors analyzed in the 2018 Final EIS/OEIS for reptiles remain valid. Updated literature is provided below for vessel strike effects on sea turtles based on recent dive behavior studies and population density information available.

G.6.2.1 Impacts from Vessels and In-Water Devices

G.6.2.1.1 Vessels

Loggerhead sea turtles are the most abundant sea turtle species found in the nearshore environment of the Study Area. Loggerheads, considered to be the most generalist of sea turtle species in terms of feeding and foraging behavior, apparently exhibit varied dive behavior that is linked to the quantity and quality of available resources and sea surface temperatures. Researchers tracked 25 female loggerheads after nesting in the Gulf of Mexico for two years; these results showed that the sea turtles dove, on average, 41.9 times per day, with most dives being 30 to 40 minutes long and within the top 25 m of the water column (Iverson et al., 2019). This demonstrates the potential vulnerability loggerheads have around vessels at all times, as the majority of their day is spent in this “strike zone” or area where there is high risk of boat strikes (Iverson et al., 2019; Patel et al., 2018; Patel et al., 2016). Arendt et al. (2012) demonstrated the distributional patterns and diving habits of 25 reproductively active and four inactive male loggerhead sea turtles in Cape Canaveral, Florida. Distribution patterns varied between breeding and non-breeding periods with resident and migrant male loggerheads co-occurring close to shore during breeding and shifting to offshore areas after the breeding period. Reproductively active males were found to make shorter dives than inactive males which is suspected to be due to energy demand of breeding males in pursuit of females. The study also found correlations between environmental conditions and dive times, with dive times being substantially longer during high winds and high waves (Arendt et al., 2012). A tracking study conducted on the dive behavior of 10 pelagic juvenile loggerhead sea turtles in the eastern North Atlantic observed greater dive activity in shallow depths (0 to 10 m) at night and during transit as compared to greater activity at depths of 10 to 50 m during the daytime when there is strong lunar illumination (Freitas et al., 2018).

Leatherback sea turtles are more likely to feed at or near the surface in open ocean areas. Chambault et al. (2017) researched the role of the Gulf Stream frontal system in the selection of specific areas for sea turtles to habituate after mating and found that they also spend the majority of their time in the upper approximately 40 m of the water column. This study found that their choice of more long-term habitat was strongly correlated with phytoplankton blooms, which bring ample nutrients into the mixed layer of the water column. It is important to note that leatherbacks can demonstrate diving behavior while foraging for jellyfish, but bring them back to the surface to ingest (Benson et al., 2007; Chambault et al., 2017; Dodge et al., 2014; Fossette et al., 2007; James & Herman, 2001). Research conducted by National Marine Fisheries Service (2022c) provides a more recent look at the leatherback turtle’s swimming patterns and diving habits along the east coast of the United States. The range at which they would travel at long distances spanned from as far south as Florida to as far north as Nova Scotia, and having concentrated movements between North Carolina and Massachusetts during non-migration stages of life. Depth sensors

showed that during the months of February, March, and May, sea turtles spent most of their time during the day within the top 2 m of the water column (National Marine Fisheries Service, 2022c).

Green, hawksbill, loggerhead, and Kemp's ridley sea turtles are more likely to forage in coastal and inshore waters, and although they may feed along the seafloor, they surface periodically to breathe while feeding and moving between near shore habitats. Kemp's ridley and loggerhead sea turtles can spend extended periods foraging at depth (meaning any depth greater than an assumed visible depth of 4 m), even in open-ocean areas (DiMatteo et al., 2022; Roberts et al., 2022; Sasso & Witzell, 2006; Seney, 2016; Servis et al., 2015). Overall, each species only spent on average approximately 16 to 18 percent of the time at the surface, while the rest of the time was scattered throughout the rest of the top 25 to 30 m layer of the water column (Roberts et al., 2022). A study by Stokes et al. (2023) showed that for hawksbills, there was a strong correlation of dive depth with temperature, but also to tidal patterns, with dives becoming longer and deeper during high tide. Hawksbills were found to spend the majority of their time in the upper approximately 5 m of the water column (Stokes et al., 2023). Welsh and Witherington (2023) conducted a study in Florida on vulnerability of vessels strikes for loggerhead, green, and leatherback sea turtles. In this study, "vulnerable turtles" were defined as ones within the typical "strike zone" (depth of water that an engine, propeller, skeg, or hull of a vessel sits at when underway). Researchers considered any sea turtle within one meter of the surface to be vulnerable; the sightings consisted of 181 green sea turtles, 171 loggerhead sea turtles, and 2 leatherback sea turtles. Higher densities of sea turtles were observed during spring and summer months, and they are often seen basking on the water's surface for means of foraging or mating (Welsh & Witherington, 2023).

Basking on the water's surface is also common for all species in the Study Area as a strategy to thermoregulate and, also places them in the part of the water column that is exposed to boat traffic. The reduced activity associated with basking may pose higher risks for sea turtle strikes because of a likely reduced capacity to avoid cues (Foley et al., 2019).

Density surface models are typically used for understanding sea turtle spatial distribution and can be used to assess coastal exposure of sea turtles to vessel strike hazards (see summaries of predicted densities for green, Kemp's ridley, leatherback, and loggerhead turtles off the United States east coast and in the Gulf of Mexico, as provided by DiMatteo et al. (2024), Garrison et al. (2023), and Rappucci et al. (2023). A study by Chaloupka et al. (2008), however, found that a vessel management zone closest to shore would be more efficient in protecting mating and inter-nesting sea turtles from vessel strikes near nesting beaches. Smaller, faster vessels that operate in nearshore waters, where green, Kemp's ridley, loggerhead, and hawksbill sea turtles can be more densely concentrated, pose a greater risk (Chaloupka et al., 2008). For example, Kemp's ridley and loggerhead sea turtle occurrence increases in nearshore areas within the Chesapeake Bay from late spring to early fall, most likely due to foraging (Barco et al., 2018a; Barco et al., 2018b). Other studies have shown that the potential for vessel strike increases in areas important for foraging sea turtles (Denkinger et al., 2013). Loggerhead turtle preferred habitat was found to extend farther north in the Chesapeake Bay as well as in deeper areas of the Bay compared to Kemp's ridley turtles (DiMatteo et al., 2022).

G.6.3 ENTANGLEMENT STRESSORS

The background information for entanglement stressor effects on reptiles in the Study Area as described in the 2018 Final EIS/OEIS ([Section 3.8.3.5](#)) has not appreciably changed. Updated research on entanglement impacts (specifically from wires and cables) to sea turtles is presented below, while the information on decelerators/parachutes and biodegradable polymers presented in the 2018 Final EIS/OEIS remains valid.

G.6.3.1 Impacts from Wires and Cables

For a discussion of the types of activities that use wires and cables see [Appendix B](#) (Activity Stressor Matrices). For a discussion on where they are used and how many wires and cables would be expended under each alternative, see [Section 3.0.3.3.5](#) (Entanglement Stressors) in this Supplemental EIS/OEIS. A sea turtle that becomes entangled in nets, lines, ropes, or other foreign objects under water may suffer temporary hindrance to movement before it frees itself or may remain entangled. The sea turtle may suffer minor injuries but recover fully, or it may die as a result of the entanglement.

Bathythermographs, which are instruments used to measure water temperature with depth, are used by the Navy during training and testing. The device is made up of a probe carrying a temperature sensor and a transducer, which is dropped nearly freely through the water column until reaching a pre-determined depth. At depth, the temperature sensor and transducer are stopped from falling by a wire attached to the rest of the bathythermograph at the surface. This wire can cause risk of entanglement in sea turtles, as it is used in the same layer of the water column in which they occupy the majority of their time (National Oceanic and Atmospheric Administration, 2024).

Increased risk of sea turtle interactions with fiber-optic cables include the amount of time it is in the same vicinity of a sea turtle; however, these cables will only be within the water column during the activity and while they sink. The likelihood of a sea turtle, especially hatchlings and pre-recruitment juveniles due to their occurrence at or near the water's surface, encountering and becoming entangled within the water column is extremely low. Further, activities that use fiber-optic cables occur in deep waters. These factors reduce the likelihood that a fiber-optic cable would be in close proximity to a sea turtle. The cable is only buoyant during the training and testing activity, and subsequently sinks after use to rest in the benthic habitats. Updated literature on entanglement to sea turtles is discussed below.

Coastal waters off Massachusetts are an important seasonal habitat for leatherbacks, most likely due to the spring production peak that occurs in this coastal ecosystem (Dodge et al., 2014). Recent studies by Dodge et al. (2022) analyzed a 15-year dataset of entanglement reports to characterize sea turtle bycatch in fisheries in Massachusetts. The study took place primarily within the Massachusetts jurisdiction off Cape Cod, and entangled sea turtles were found both nearshore and offshore towards Martha's Vineyard and Nantucket Island. With this data, researchers were able to determine the number of sea turtles that were injured or dead as a result of entanglement, as well as analyze the behavior and recovery or survival rate of alive sea turtles found entangled. The study focused on adult males, adult females, and subadults. Of the 280 confirmed sea turtle entanglements documented during this study, 272 were leatherback turtles. The majority of sea turtles were entangled in actively fished and commercial areas, and entanglements occurred from May to November, with peak reporting in August. A total of 224 entangled leatherbacks were found alive at first sighting, 47 were found dead in gear, and 1 case was unknown. Though data was limited on the survival rate of alive entangled sea turtles, post-release monitoring suggested they can survive days, even years after entanglement (Dodge et al., 2022).

Research conducted by Duncan et al. (2017) also demonstrated the consequences of sea turtles interacting with anthropogenic devices or debris on a global scale; of the thousands of sea turtle strandings encountered by the observers, across six species and all life stages, 5.5% were found entangled, and 90.6% of these were dead. The majority of recorded entanglements were with lost or discarded fishing gear. It is evident that anthropogenic materials, such as some of the wires and cables that will be used during training and testing activities, are a serious hazard to sea turtles; however, this interaction is expected to be minimal, and wires and cables as an entanglement stressor do not pose a significant threat to sea turtle species during training and testing activities.

G.6.4 INGESTION STRESSORS

The background information for ingestion stressor effects on reptiles in the Study Area as described in the 2018 Final EIS/OEIS ([Section 3.8.3.6](#)) has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS remains valid.

G.6.5 SECONDARY STRESSORS

There is the potential for impacts on sea turtles, crocodilians, and terrapins exposed to stressors indirectly through impacts on their habitat (sediment or water quality) or prey availability. For the purposes of this analysis, indirect impacts on reptiles via sediment or water quality that do not require trophic transfer (e.g., bioaccumulation) to be observed are considered here. Bioaccumulation considered previously in this document in the analyses of fishes ([Section 3.6](#)), invertebrates ([Section 3.5](#)), and marine habitats ([Section 3.3](#)) indicated minimal to no impacts on potential prey species of sea turtles, crocodilians, or terrapins. It is important to note that the terms “indirect” and “secondary” do not imply reduced severity of environmental consequences but instead describe how the impact may occur in an organism.

Stressors from training and testing activities that could pose indirect impacts on sea turtles via habitat or prey include: (1) explosives, (2) explosive byproducts and unexploded munitions, (3) metals, and (4) chemicals. Stressors from training and testing activities that could pose indirect impacts on crocodilians or terrapins via habitat or prey include metals from training and testing activities within inshore waters. Analyses of the potential impacts on sediment and water quality are discussed in [Section 3.2](#) (Sediment and Water Quality).

The background information for secondary stressor effects including explosives, explosive byproducts, and chemicals on reptiles and metals on crocodilians and terrapins in the Study Area as described in the 2018 Final EIS/OEIS ([Section 3.8.3.7](#)) has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS remains valid. Updated research on the impact of metals on sea turtles has been incorporated since 2018, and a summary of the findings are presented below.

G.6.5.1 Metals

Metals are introduced into seawater and sediments as a result of training and testing activities involving ship hulks, targets, munitions, and other military expended materials (see 2018 EIS/OEIS [Section 3.0.3.3.2](#), Explosive Stressors) (Environmental Sciences Group, 2005). Some metals bioaccumulate and physiological impacts begin to occur only after several trophic transfers concentrate the toxic metals ([Section 3.3](#), Habitats, and [Chapter 4](#), Cumulative Impacts). Evidence from several studies (Briggs et al., 2016; Koide et al., 2016) indicate metal contamination is very localized and that bioaccumulation resulting from munitions cannot be demonstrated. Specifically, in sampled marine life living on or around munitions on the seafloor, metal concentrations could not be definitively linked to the munitions since comparison of metals in sediment next to munitions show relatively little difference in comparison to other “clean” marine sediments used as a control/reference (Koide et al., 2016). Recent literature by Shaw et al. (2023) studied green sea turtles that resided near a shooting range in Kailua Bay, Oahu to determine if they had elevated blood and scute lead, arsenic, and antimony concentrations as a result of lead deposition at the site. Results found that the sea turtles had higher lead concentrations than reference populations due to their close proximity to the gun range and residing in an area with such heavy metal deposition into the land. Intake of metals at higher rates could pose a range of problems for these species, as metal ingestion is known to have detrimental health effects. In this study, negative relationships between concentration of metals found in blood and variables such as growth rate and reproductive success

were found among green sea turtles (Shaw et al., 2023). Research has demonstrated that some smaller marine organisms are attracted to metal munitions as a hard substrate for colonization or as shelter (Smith & Marx, 2016). Although this would likely increase prey availability for some benthic foraging sea turtles that feed on molluscs (e.g., loggerheads), the relatively low density of metals deposited by training and testing activities compared to concentrated dump and range sites would not likely substantively benefit sea turtles. Inshore waters, which would receive small-caliber shells from training activities have the potential to be deposited in substrates in estuaries used by some sea turtles (in particular Kemp's ridley, loggerhead, and green sea turtles).

G.7 BIRDS AND BATS

G.7.1 ENERGY STRESSORS

Following a review of recent literature, the background information for energy stressor effects on birds and bats in the Study Area as described in the 2018 Final EIS/OEIS has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS ([Section 3.9.3.3](#)) remains valid.

G.7.2 PHYSICAL DISTURBANCE AND STRIKE STRESSORS

Following a review of recent literature, the background information for physical disturbance and strike stressor effects on birds and bats in the Study Area as described in the 2018 Final EIS/OEIS has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS ([Section 3.9.3.4](#)) remains valid.

G.7.3 ENTANGLEMENT STRESSORS

Following a review of recent literature, the background information for entanglement stressor effects on birds and bats in the Study Area as described in the 2018 Final EIS/OEIS has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS ([Section 3.9.3.5](#)) remains valid.

G.7.4 INGESTION STRESSORS

Following a review of recent literature, the background information for ingestion stressor effects on birds and bats in the Study Area as described in the 2018 Final EIS/OEIS has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS ([Section 3.9.3.6](#)) remains valid.

G.7.5 SECONDARY STRESSORS

Following a review of recent literature, the background information for secondary stressor effects on birds and bats in the Study Area as described in the 2018 Final EIS/OEIS has not appreciably changed. As such, the information presented in the 2018 Final EIS/OEIS ([Section 3.9.3.7](#)) remains valid.

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