3.5 Sea Turtles

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3.5.1 Affected Environment

This section analyzes potential impacts on sea turtles found in the Northwest Training and Testing (NWTT) Study Area (Study Area). As noted in Section 3.5 (Sea Turtles) in the 2015 NWTT Final Environmental Impact Statement (EIS)/Overseas EIS (OEIS), the leatherback sea turtle (*Dermochelys coriacea*), a cold-water adapted species, is the only species of sea turtle expected to occur within the Study Area. Other species of sea turtles (loggerhead sea turtle [*Caretta caretta*], olive ridley sea turtle [*Lepidochelys olivacea*], and green sea turtle [*Chelonia mydas*]) are considered tropical, subtropical, and warm temperate species and rarely stray into cold waters. If these species were found in the Study Area they would be likely become cold stressed in the environment to the point of stranding or death and therefore are not carried forward for further analysis.

Within the Study Area, leatherback sea turtles are only expected to occur within the Offshore Area; therefore, training and testing activities that would occur in the Inland Waters or Western Behm Canal, Alaska, are not analyzed for potential impacts on the leatherback sea turtle (see Section 3.5.2.4.2, Habitat and Geographic Range, in the 2015 NWTT Final EIS/OEIS).

The Navy conducted a literature search for any new information that pertains to the leatherback sea turtles' status and distribution within the Study Area. This information is included in the following subsections. In addition, the Navy's literature search included a review of any new information on other sea turtle species that may occur within the Study Area. Based on this review, there is no new substantive information on other sea turtle species that may occur within the Study Area, and the Navy determined that inclusion of other sea turtle species for analysis in this Supplemental EIS/OEIS (Supplemental) is not warranted. The Navy also reviewed the status and distribution of other pelagic reptile species, such as sea snakes, to evaluate if these species should be included in this Supplemental. Although there are recent sightings of yellow-bellied sea snakes off the coast of southern California, the Navy's review of recent literature published since the 2015 NWTT Final EIS/OEIS found no records or anecdotal sightings of sea snakes within the Study Area. Therefore, sea snakes are not included in this Supplemental.

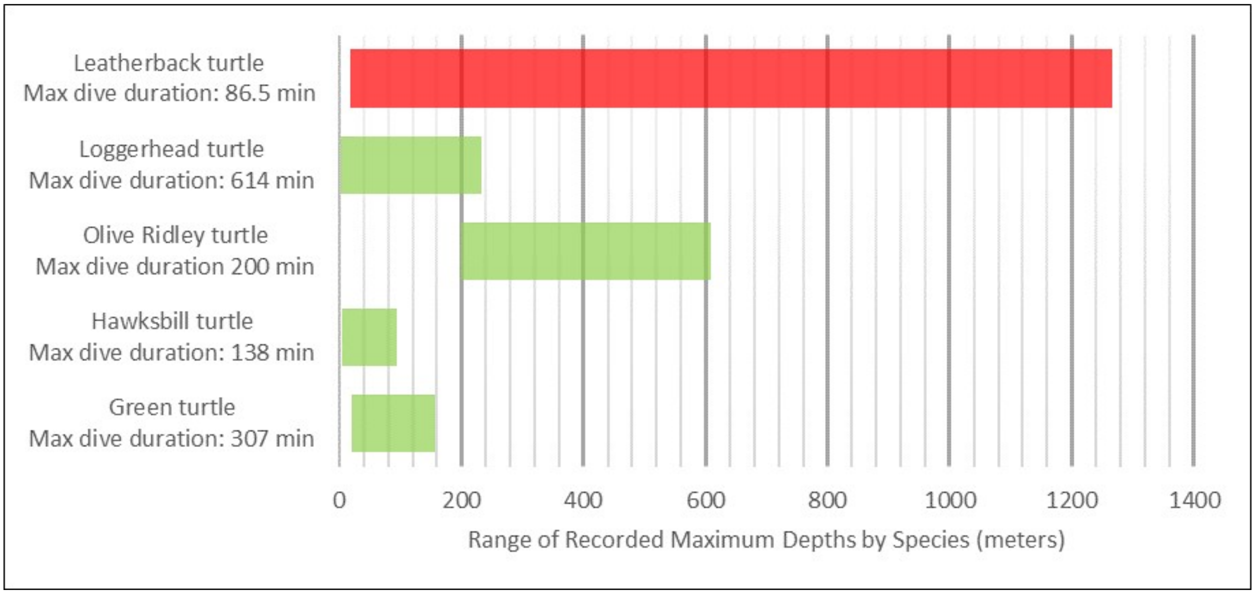
The 2015 NWTT Final EIS/OEIS provided a general overview of sea turtle diving, hearing and vocalizations, and general threats. New information since the publication of the 2015 NWTT Final EIS/OEIS is included below to better understand potential stressors and impacts on sea turtles resulting from training and testing activities.

3.5.1.1 Diving

Sea turtle dive depth and duration varies by species, the age of the animal, the location of the animal, and the activity (foraging, resting, and migrating). The leatherback is the deepest diving sea turtle, with a recorded maximum depth of 4,200 feet (ft.) (1,280 meters [m]) (Houghton et al., 2008), although most dives are much shallower (usually less than 820 ft. [250 m]) (Hays et al., 2004b; Hays et al., 2004c; Sale et al., 2006; Wallace et al., 2015). Diving activity (including surface time) is influenced by a suite of environmental factors (e.g., water temperature, availability and vertical distribution of food resources, bathymetry) that result in spatial and temporal variations in dive behavior (James et al., 2006; Sale et al., 2006; Wallace et al., 2016).

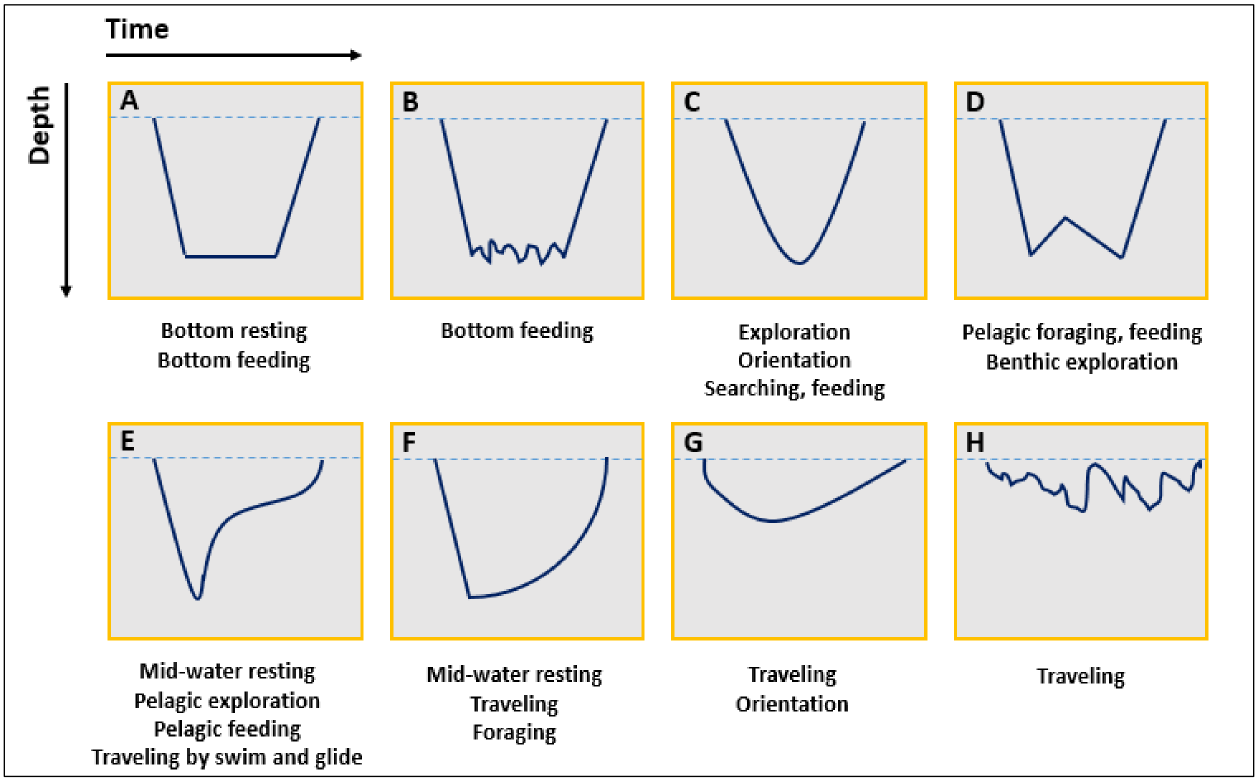
No new information is available on leatherback sea turtle diving behavior that would alter the analysis from the 2015 NWTT Final EIS/OEIS; however, Hochscheid (2014) has completed a species-specific summary for sea turtles within the Study Area that was not included in the 2015 NWTT Final EIS/OEIS. Hochscheid (2014) collected data from 57 studies published between 1986 and 2013, which summarized depths and durations of dives of datasets including an overall total of 538 sea turtles. Figure 3.5-1 presents the ranges of maximum dive depths for different sea turtle species that shows the unique diving capabilities of leatherback sea turtles compared to other sea turtle species. This summary can improve the exposure analysis for stressors analyzed in Section 3.5.2 (Environmental Consequences).

Hochscheid (2014) also collected information on generalized dive profiles, with correlations to specific activities, such as bottom resting, bottom feeding, orientation and exploration, pelagic foraging and feeding, mid-water resting, and traveling during migrations. Generalized dive profiles compiled from 11 different studies show eight distinct profiles tied to specific activities. These profiles and activities are shown in Figure 3.5-2.



Sources: Hochscheid (2014), Sakamoto et al. (1993), Rice and Balazs (2008), Gitschlag (1996), Salmon et al. (2004)

Figure 3.5-1: Dive Depth and Duration Summaries for Sea Turtle Species



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

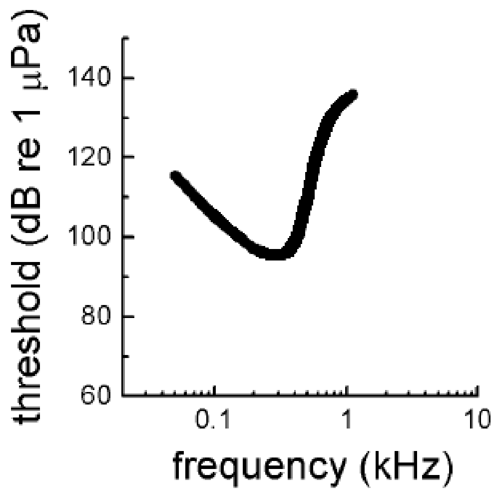
Notes: Profiles A-H, as reported in the literature and compiled by Hochscheid (2014). The depth and time arrows indicate the axis variables, but the figure does not represent true proportions of depths and durations for the various profiles. In other words, the depths can vary greatly, but behavioral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

Figure 3.5-2: Generalized Dive Profiles and Activities Described for Sea Turtles

3.5.1.2 Hearing and Vocalization

Sea turtle ears are adapted for hearing underwater and in air, with auditory structures that may receive sound via bone conduction (Lenhardt et al., 1985), via resonance of the middle ear cavity (Willis et al., 2013), or via standard tympanic middle ear path (Hetherington, 2008). Studies of hearing ability show that sea turtles' ranges of in-water hearing detection generally lie between 50 and 1600 hertz (Hz), with maximum sensitivity between 100 and 400 Hz, and that hearing sensitivity drops off rapidly at higher frequencies. Sea turtles are also limited to low-frequency hearing in-air, with hearing detection in juveniles possible between 50 and 800 Hz, with a maximum hearing sensitivity around 300–400 Hz (Bartol & Ketten, 2006; Piniak et al., 2016). Hearing abilities have primarily been studied with sub-adult, juvenile, and hatchling subjects in four sea turtle species, including green (Bartol & Ketten, 2006; Ketten & Moein-Bartol, 2006; Piniak et al., 2016; Ridgway et al., 1969; Yudhana et al., 2010), olive ridley (Bartol & Ketten, 2006), loggerhead (Bartol et al., 1999; Lavender et al., 2014; Martin et al., 2012), and leatherback (Dow Piniak et al., 2012). Only one study examined the auditory capabilities of an adult sea turtle (Martin et al., 2012); the hearing range of the adult loggerhead turtle was similar to other measurements of juvenile and hatchling sea turtle hearing ranges.

Using existing data on sea turtle hearing sensitivity, the U.S. Department of the Navy (Navy) developed a composite sea turtle audiogram for underwater hearing (Figure 3.5-3), as described in the technical report *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (U.S. Department of the Navy, 2017a).



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

Figure 3.5-3: Composite Underwater Audiogram for Sea Turtles

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

Some sounds have been recorded during nesting activities ashore, including belch-like sounds and sighs (Mrosovsky, 1972), exhale/inhales, gular pumps, and grunts (Cook & Forrest, 2005) by female leatherback turtles, and low-frequency pulsed and harmonic sounds by leatherback embryos in eggs and hatchlings (Ferrara et al., 2014; Ferrara et al., 2019; McKenna et al., 2019).

3.5.1.3 General Threats

The general threats to sea turtles are described in the 2015 NWTT Final EIS/OEIS. New information is available that provides a more refined understanding of how bycatch, ship strikes, marine debris, climate change, and nesting can potentially threaten sea turtle species within the Study Area. Although the information summarized below is from more recent literature since the publication of the 2015 NWTT Final EIS/OEIS, the information presented in the 2015 NWTT Final EIS/OEIS remains valid. The analysis of potential impacts of activities described in this Supplemental benefit from an increased understanding of how marine debris and climate change can potentially threaten leatherback sea turtles within the Study Area.

3.5.1.3.1 Marine Debris

Ingestion of marine debris can cause mortality or injury to leatherback sea turtles. The United Nations Environment Programme estimates that approximately 6.4 million tons of anthropogenic debris enters the marine environment every year (Jeftic et al., 2009; Richardson et al., 2016; Schuyler et al., 2016).

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

3.5.1.3.2 Climate Change

Since the publication of the 2015 NWTT Final EIS/OEIS, the Navy has obtained and consolidated additional information to conceptualize the potential of climate change to threaten sea turtle species within the Study Area. Sea turtles are particularly susceptible to climate change effects because their life history, physiology, and behavior are extremely sensitive to environmental temperatures (Fuentes et al., 2013). Climate change models predict sea level rise and increased intensity of storms and hurricanes in tropical sea turtle nesting areas (Patino-Martinez et al., 2014). These factors could significantly increase beach inundation and erosion, thus affecting water content of sea turtle nesting beaches and potentially inundating nests (Pike et al., 2015). Climate change may negatively impact turtles in multiple ways and at all life stages. These impacts may include the potential loss of nesting beaches due to sea level rise and increasingly intense storm surge (Patino-Martinez et al., 2014), feminization of turtle populations from elevated nest temperatures (and skewing populations to more females than males unless nesting shifts to northward cooler beaches) (Reneker & Kamel, 2016), decreased reproductive success (Clark & Gobler, 2016; Hawkes et al., 2006; Laloë et al., 2016; Pike, 2014), shifts in reproductive periodicity and latitudinal ranges (Birney et al., 2015; Pike, 2014), disruption of hatchling dispersal and migration, and indirect effects to food availability (Witt et al., 2010). While rising temperatures may initially result in increased female population sizes, the lack of male turtles will likely impact the overall fertility of females in the population (Jensen et al., 2018). For example, breeding male sea turtles show strong natal philopatry (the tendency for animals to return to their birth places to mate) (Roden et al., 2017; Shamblin et al., 2015). With fewer available breeding males, it is unlikely that available males from other locations would interact with females in male-depleted breeding areas (Jensen et al., 2018).

3.5.1.4 Leatherback Sea Turtle (*Dermochelys coriacea*)

3.5.1.4.1 Status and Management

The leatherback turtle is listed as a single population, classified as endangered under the Endangered Species Act (ESA), and has Critical Habitat designated within the Study Area. Although the U.S. Fish and Wildlife Service and National Marine Fisheries Service (NMFS) believe the current listing is valid, preliminary information indicates an analysis and review of the species should be conducted under the distinct population segment policy (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 2013). Recent information on population structure (through genetic studies) and distribution (through telemetry, tagging, genetic studies, and population modeling) has led to an increased understanding and refinement of the global stock structure (Clark et al., 2010; Gaspar & Lalire, 2017). This effort is critical to focus efforts to protect the species, because the status of individual stocks varies widely across the world. Unlike populations in the Caribbean and Atlantic Ocean, which are generally stable or increasing, western Pacific leatherbacks have declined more than 80 percent and eastern Pacific leatherbacks have declined by more than 97 percent since the 1980s (Kobayashi et al., 2016). Because the threats to these subpopulations have not ceased, the International Union for Conservation of Nature has predicted a decline of 96 percent for the western Pacific subpopulation and a decline of nearly 100 percent for the eastern Pacific subpopulation by 2040 (Nachtigall et al., 2016; Wallace et al., 2016).

3.5.1.4.2 Habitat and Geographic Range

In 2012, NMFS designated critical habitat for the leatherback sea turtle off the coast of Washington and Oregon, as shown in Figure 3.5-4). The designated areas comprise approximately 41,914 square miles (108,557 square kilometers) of marine habitat and include waters from the ocean surface down to a maximum depth of 262 ft. (80 m) (77 Federal Register 4170). This designation includes approximately 25,004 square miles (64,760 square kilometers) stretching from Cape Flattery, Washington, to Cape Blanco, Oregon, east of the 2,000 m depth contour, as well as 16,910 square miles (43,797 square kilometers) stretching along the California coast from Point Arena to Point Arguello east of the 3,000 m depth contour. Critical habitat overlaps with the Study Area. NMFS identified one Primary Constituent Element (PCE) essential for the conservation of leatherbacks in marine waters off the U.S. West Coast. This PCE is the occurrence of prey species, primarily scyphomedusae of the order Semaeostomeae (an order of large jellyfish) of sufficient condition, distribution, diversity, abundance, and density necessary to support individual as well as population growth, reproduction, and development.

In the 2015 NWTT Final EIS/OEIS, the Navy's analysis of leatherback sea turtles assumed that these sea turtles only inhabited the Offshore Area of the Study Area. For this Supplement, the Navy conducted a literature search of leatherback sea turtle occurrence in the Offshore Area, Inland Waters, and Western Behm Canal but did not find any additional information that would indicate the presence of leatherback sea turtles in different portions of the Study Area. New population modeling conducted by Gaspar and Lalire (2017) compare Pacific juvenile leatherback predicted distributions with passive dispersion (juvenile turtles drifting or following currents) and active dispersion, where juvenile turtles respond to habitat cues (e.g., water temperature) and actively swim to foraging grounds often counter to prevailing currents. This modeling effort suggests that oceanic currents broadly shape the dispersal area of leatherbacks within the North Central Pacific Basin, and habitat-driven movements strongly influence the spatial and temporal distribution of juveniles within this area. Specifically, these habitat-driven movements lead juveniles to gather in the North Pacific Transition Zone and to undertake seasonal north-south migrations. The modeling effort also suggests that juveniles in the North Pacific Transition Zone migrate westward, counter to prevailing currents, thereby increasing residence time. This likely exposes leatherbacks in the Pacific to increased risk of interactions with fisheries, in the central and eastern part of the North Pacific basin. Habitat-driven movements modeled by Gaspar and Lalire (2017) would also reduce the risk of cold-induced mortality. This risk appears to be larger among the juveniles that rapidly circulate into the Kuroshio Current than in other, more southern latitude currents.

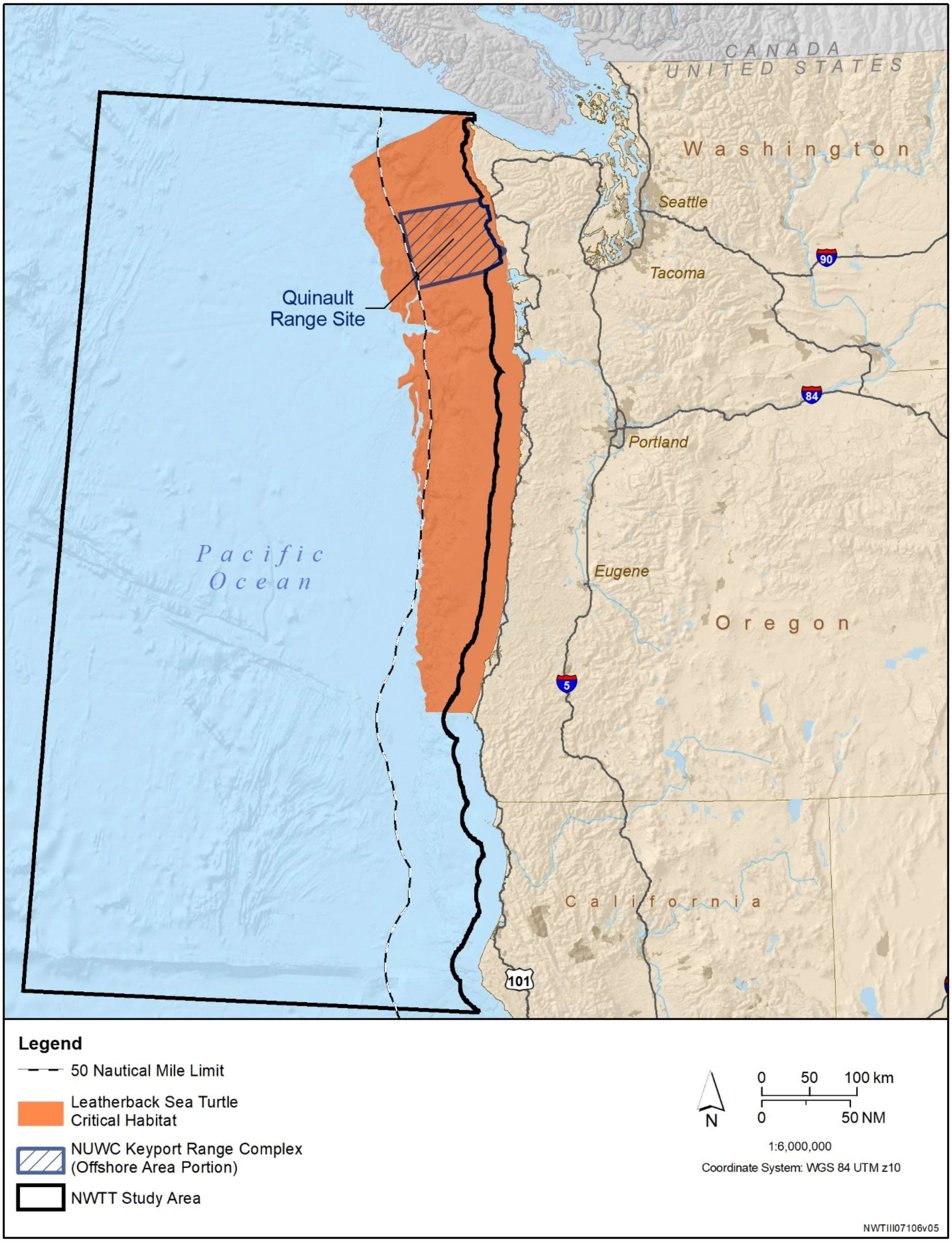


Figure 3.5-4: Designated Critical Habitat for the Leatherback Sea Turtle Within the Study Area

3.5.1.4.2.1 Population and Abundance

The eastern and western Pacific leatherback populations have been the subjects of several action plans and recovery plans over the last two decades, including the Bellagio Blueprint for Action on Pacific Sea Turtles (Polasek et al., 2017), the U.S. Recovery Plan for Pacific populations of Leatherbacks (National Marine Fisheries Service & U.S. Fish and Wildlife Service, 1998), and the North American Conservation Action Plan for Pacific Leatherback Sea Turtles (Seymour et al., 2017).

3.5.1.4.2.2 Predator-Prey Interactions

The Navy conducted a literature search of leatherback sea turtle predator-prey interactions, but did not find any additional information that would change the information presented in the 2015 NWTT Final EIS/OEIS.

3.5.1.4.2.3 Species-Specific Threats

Since the publication of the 2015 NWTT Final EIS/OEIS, National Oceanic and Atmospheric Administration Fisheries has updated their conservation strategy for Pacific leatherback sea turtles with the publication of *Species in the Spotlight Priority Actions: 2016-2020 Pacific Leatherback Turtle* Dermochelys coriacea (National Marine Fisheries Service, 2016). This plan focuses on five primary areas: (1) reducing fisheries interactions, (2) improving nesting beach protections and increasing reproductive output, (3) international cooperation, (4) monitoring and research, and (5) public engagement.

3.5.2 Environmental Consequences

In the 2015 NWTT Final EIS/OEIS, the Navy considered all potential stressors associated with ongoing training and testing in the Study Area and then analyzed their potential impacts on leatherback sea turtles and leatherback designated critical habitat in the Study Area. In this Supplemental, the Navy has reviewed the analysis of impacts from these ongoing activities and additionally analyzed new or changing military readiness activities as projected into the reasonably foreseeable future. The projected future actions are based on evolving operational requirements, including those associated with any anticipated new platforms or systems not previously analyzed. Because leatherback sea turtles are not expected to occur in the Inland Waters or Western Behm Canal portions of the Study Area, only those activities proposed to occur in the Offshore Area are considered.

The Navy has completed a literature review for information on sea turtles within the Study Area, which included a search for the best available science since the publication of the 2015 NWTT Final EIS/OEIS. Where there has been no substantive or otherwise meaningful change in the action, science, or regulations, the Navy will rely on the previous 2015 NWTT Final EIS/OEIS analysis. Where there has been substantive change in the action, science, or regulations, the information provided in this Supplemental supplements the 2015 NWTT Final EIS/OEIS to support environmental compliance with applicable environmental statutes for sea turtles.

In the Proposed Action for this Supplemental, there have been some modifications to the quantity and type of acoustic stressors under the two action alternatives. There are also new acoustic impact criteria, hearing weighting functions, and sea turtle densities. In addition, as stated in Section 3.0 (Introduction), there are new activities being proposed. One new testing activity involves the use of high-energy laser weapons in the Study Area (as an Energy stressor) as detailed in Section 3.0.3.3.2 (Lasers). Another new testing activity involves the use of a biodegradable polymer (as an Entanglement stressor) as detailed in Section 3.0.3.5.3 (Biodegradable Polymer).

In general, there have been no substantial changes to the activities analyzed as the Proposed Action in the 2015 NWTT Final EIS/OEIS which would change the conclusions reached regarding populations of sea turtles in the Study Area. Use of acoustic stressors (sonar and other active acoustic sources) and use of explosives have occurred since the completion of the 2015 NWTT Final EIS/OEIS Record of Decision and the 2015 NMFS Biological Opinion. There have been no known adverse effects to sea turtles, impacts on leatherback sea turtle prey items, or population impacts that were not otherwise previously analyzed or accounted for in the 2015 NWTT Final EIS/OEIS or the NMFS Biological Opinion pursuant to the ESA (National Oceanic and Atmospheric Administration, 2015b) with regard to acoustic or explosive stressors. The potential stressors associated with the training and testing activities in the Study Area included the following:

- **Acoustic** (sonar and other transducers, vessel noise, aircraft noise, weapon noise)
- **Explosives** (in water explosions)
- **Energy** (in-water electromagnetic devices, high-energy laser weapons)
- **Physical disturbance and strike** (vessels and in-water devices, military expended materials, seafloor devices)
- **Entanglement** (wires and cables, decelerators/parachutes, biodegradable polymer)
- **Ingestion** (military expended materials, munitions, military expended materials – other than munitions)
- **Secondary stressors** (impacts on habitat, impacts on prey availability)

In 2015, NMFS determined that within the Study Area, only acoustic stressors and explosive stressors could potentially result in the incidental take of leatherback sea turtles from Navy training and testing activities. None of the other stressors would result in significant adverse impacts or jeopardize the continued existence of leatherback sea turtle species (National Oceanic and Atmospheric Administration, 2015b).

As detailed in Chapter 2 (Description of Proposed Action and Alternatives) of this Supplemental, the only substantive changes in the Proposed Action are those specified eliminations, increases, or decreases in the use of sonar and other active acoustic sources and the use of in-water explosives, and the introduction of high energy lasers and biodegradable polymers. Table 2.5-1, Table 2.5-2, and Table 2.5-3 in Chapter 2 (Description of Proposed Action and Alternatives) list the proposed training and testing activities and include the number of times each activity would be conducted annually and the locations within the Study Area where the activity would typically occur under each alternative. The tables also present the same information for activities presented in the 2015 NWTT Final EIS/OEIS so that the proposed levels of training and testing under this Supplemental can be compared. As presented in Section 3.0 (Introduction), since completion of the 2015 NWTT Final EIS/OEIS there have been refinements made in the modeling of potential impacts from sonar and other active acoustic sources and explosives, presented below under the acoustics and explosives stressor sections.

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

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

3.5.2.1 Acoustic Stressors

The analysis of effects to sea turtles follows the concepts outlined in Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities). This section begins with a summary of relevant data regarding acoustic impacts on sea turtles in Section 3.5.2.1.1 (Background). This is followed by an analysis of estimated impacts on sea turtles due to specific Navy acoustic stressors (sonar and other transducers, vessel noise, aircraft noise, and weapon noise). Additional explanations of the acoustic terms and sound energy concepts used in this section are found in Appendix D (Acoustic and Explosive Concepts). Studies of the effects of sound on sea turtles are limited; therefore, where necessary, knowledge of impacts on other species from acoustic stressors is used to assess impacts on sea turtles.

The Navy will rely on the previous 2015 NWTT Final EIS/OEIS for the analysis of vessel noise, aircraft noise, and weapon noise, and new applicable and emergent science in regard to these sub-stressors is presented in the sections which follow. Due to new acoustic impact criteria, sea turtle densities, and revisions to the Navy Acoustic Effects Model, the analysis provided in Section 3.5.2.1.2 (Impacts from Sonar and Other Transducers) of this Supplemental will supplant the 2015 NWTT Final EIS/OEIS for sea turtles, and may result in changes to estimated impacts since the 2015 NWTT Final EIS/OEIS.

3.5.2.1.1 Background

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

3.5.2.1.1.1 Injury

The high peak pressures close to some non-explosive impulsive underwater sound sources may be injurious, although there are no reported instances of injury to sea turtles caused by these sources. A Working Group organized under the American National Standards Institute-Accredited Standards Committee S3, Subcommittee 1, Animal Bioacoustics, developed sound exposure guidelines for fish and sea turtles (Popper et al., 2014), hereafter referred to as the *ANSI Sound Exposure Guidelines*. Lacking any data on non-auditory sea turtle injuries due to sonars, the working group estimated the risk to sea turtles from low-frequency sonar to be low and mid-frequency sonar to be non-existent.

As discussed in Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities, specifically Section 3.0.3.7.1, Injury), mechanisms for non-auditory injury due to acoustic exposure have been hypothesized for diving breath-hold animals. Acoustically induced bubble formation, rectified diffusion, and acoustic resonance of air cavities are considered for their similarity to pathologies observed in marine mammals stranded coincident with sonar exposures but were found to not be likely causal mechanisms (Section 3.5.2.1.1.1, Injury), and findings are applicable to sea turtles.

Nitrogen decompression due to modifications to dive behavior has never been observed in sea turtles. Sea turtles are thought to deal with nitrogen loads in their blood and other tissues, caused by gas exchange from the lungs under conditions of high ambient pressure during diving, through anatomical, behavioral, and physiological adaptations (Lutcavage & Lutz, 1997). Although diving sea turtles experience gas supersaturation, gas embolism has only been observed in sea turtles bycaught in fisheries, including loggerhead sea turtles (Garcia-Parraga et al., 2014), as well as leatherback, green, and olive ridley sea turtles (Crespo-Picazo et al., 2020). Therefore, nitrogen decompression due to changes in diving behavior is not considered a potential consequence to diving sea turtles.

Hearing Loss

Exposure to intense sound may result in hearing loss, typically quantified as threshold shift, which persists after cessation of the noise exposure. Threshold shift is a loss of hearing sensitivity at an affected frequency of hearing. This noise-induced hearing loss may manifest as temporary threshold shift (TTS), if hearing thresholds recover over time, or permanent threshold shift (PTS), if hearing thresholds do not recover to pre-exposure thresholds. Because studies on inducing threshold shift in sea turtles are very limited (e.g., alligator lizards: Dew et al., 1993; Henry & Mulroy, 1995), are not sufficient to estimate TTS and PTS onset thresholds, and have not been conducted on any of the sea turtles present in the Study Area, auditory threshold shift in sea turtles is considered to be consistent with general knowledge about noise-induced hearing loss described in Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities).

Because there are no data on auditory effects on sea turtles, the ANSI Sound Exposure Guidelines (Popper et al., 2014) do not include numeric sound exposure thresholds for auditory effects on sea turtles. Rather, the guidelines qualitatively estimate that sea turtles are less likely to incur TTS or PTS with increasing distance from various sound sources. The guidelines also suggest that data from fishes may be more relevant than data from marine mammals when estimating impacts on sea turtles, because, in general, fish hearing range is more similar to the limited hearing range of sea turtles. As shown in Section 3.5.1.2 (Hearing and Vocalization), sea turtle hearing is most sensitive around 100–400 Hz in-water, is limited over 1 kilohertz (kHz), and is much less sensitive than that of any marine mammal. Therefore, sound exposures from most mid-frequency and all high-frequency sound sources are not anticipated to affect sea turtle hearing, and sea turtles are likely only susceptible to auditory impacts when exposed to very high levels of sound within their limited hearing range.

3.5.2.1.1.2 Physiological Stress

A stress response is a suite of physiological changes meant to help an organism mitigate the impact of a stressor. If the magnitude and duration of the stress response is too great or too long, then it can have negative consequences to the animal (e.g., decreased immune function, decreased reproduction). Physiological stress is typically analyzed by measuring stress hormones, other biochemical markers, or vital signs. Physiological stress has been measured for sea turtles during nesting (Flower et al., 2015; Valverde et al., 1999), capture and handling (Flower et al., 2015; Gregory & Schmid, 2001), and when caught in entanglement nets (Hoopes et al., 2000; Snoddy et al., 2009) and trawls (Stabenau et al., 1991). However, the stress caused by acoustic exposure has not been studied for sea turtles. Therefore, the stress response in sea turtles in the Study Area due to acoustic exposures is considered to be consistent with general knowledge about physiological stress responses described in Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities).

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

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

3.5.2.1.1.3 Masking

As described in Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities), auditory masking occurs when one sound, distinguished as the "noise," interferes with the detection or recognition of another sound or limits the distance over which other biologically relevant sounds, including those produced by prey, predators, or conspecifics, can be detected. Masking only occurs when the sound source is operating; therefore, direct masking effects stop immediately upon cessation of the sound-producing activity. Any sound above ambient noise and within an animal's hearing range may potentially cause masking.

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

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

3.5.2.1.1.4 Behavioral Reactions

Behavioral responses fall into two major categories: Alterations in natural behavior patterns and avoidance. These types of reactions are not mutually exclusive and reactions may be combinations of behaviors or a sequence of behaviors. As described in Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities), the response of a reptile to an anthropogenic sound would likely depend on the frequency, duration, temporal pattern, and amplitude of the sound as well as the animal's prior experience with the sound and the context in which the sound is encountered (i.e., what the animal is doing at the time of the exposure). Distance from the sound source and whether it is perceived as approaching or moving away may also affect the way a reptile responds to a sound.

Sea turtles may detect sources below 2 kHz but have limited hearing ability above 1 kHz. They likely detect most broadband sources (including vessel noise) and low-frequency sonars, so they may respond to these sources. Because auditory abilities are poor above 1 kHz, detection and consequent reaction to any mid-frequency source is unlikely.

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

Behavioral Reactions to Impulsive Sound Sources

There are limited studies of reptile responses to sounds from impulsive sound sources, and all data come from sea turtles exposed to seismic air gun, although air guns are not used during Navy training or testing activities. These exposures consist of multiple air gun shots, either in close proximity or over long durations, so it is likely that observed responses may over-estimate responses to single or short-duration impulsive exposures. Studies of responses to air guns are used to inform reptile responses to other impulsive sounds (e.g., some weapon noise).

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

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

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

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

Based on the limited sea turtle behavioral response data discussed above, sea turtle behavioral responses to impulsive sounds could consist of temporary avoidance, increased swim speed, or changes in depth; or there may be no observable response. Based on the behavioral response severity scale developed by Southall et al. (2007), the severity of these responses can be categorized as non-existent, low, and moderate.

Behavioral Reactions to Sonar and Other Transducers

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

According to the qualitative risk factors developed in the *ANSI Sound Exposure Guideline Technical Report* (Popper et al., 2014), the likelihood of sea turtles responding to low- and mid-frequency sonar is low and highly unlikely, respectively. Based on the limited sea turtle behavioral response data discussed above, sea turtle behavioral responses to non-impulsive sounds could consist of temporary avoidance, increased swim speed, or no observable response. Using the behavioral response severity scale developed by Southall et al. (2007), the severity of these responses can be categorized as non-existent, low, and moderate.

3.5.2.1.1.5 Long-Term Consequences

For the sea turtles present in the Study Area, long-term consequences to individuals and populations due to acoustic exposures have not been studied. Therefore, long-term consequences to sea turtles due to acoustic exposures are considered following Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities).

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

3.5.2.1.2 Impacts from Sonar and Other Transducers

The overall use of sonar and other transducers for training and testing activities would be similar to what is currently conducted (Table 3.0-2 for details). Although individual activities may vary some from those previously analyzed, the overall determinations presented in the 2015 NWTT Final EIS/OEIS remain valid. The quantitative analysis has been updated since the 2015 NWTT Final EIS/OEIS; therefore, the new analysis is fully presented and described in further detail in the technical report *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2017b).

Activities using sonars and other transducers would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activities Descriptions). Sonar and other transducers proposed for use are transient in most locations because activities that involve sonar and other transducers take place at different locations and many platforms are generally moving throughout the Study Area. Sonar and other transducers emit sound waves into the water to detect objects, safely navigate, and communicate. General categories of these systems are described in Section 3.0.3.1 (Acoustic Stressors). The activities that use sonar and other transducers are described in Appendix A (Navy Activities Descriptions).

Sonar-induced acoustic resonance and bubble formation phenomena are very unlikely to occur under realistic conditions, as discussed in Section 3.5.2.1.1.1 (Injury). Non-auditory injury (i.e., other than PTS) and mortality from sonar and other transducers is so unlikely as to be discountable under normal conditions and is therefore not considered further in this analysis.

Potential impacts considered from exposure to sonar and other transducers are hearing loss due to threshold shift (permanent or temporary), physiological stress, masking of other biologically relevant sounds, and changes in behaviors, as described in Section 3.5.2.1.1.2 (Hearing Loss), Section 3.5.2.1.1.3 (Physiological Stress), Section 3.5.2.1.1.4 (Masking), and Section 3.5.2.1.1.5 (Behavioral Reactions).

3.5.2.1.2.1 Methods for Analyzing Impacts from Sonar and Other Transducers

The Navy performed a quantitative analysis to estimate the number of times that sea turtles could be affected by sonar and other transducers used during Navy training and testing activities. The Navy's quantitative analysis to determine impacts to sea turtles and marine mammals uses the Navy Acoustic Effects Model to produce initial estimates of the number of times these animals may experience these effects; these estimates are further refined by considering animal avoidance of sound-producing activities and implementation of mitigation. The steps of this quantitative analysis take into account:

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

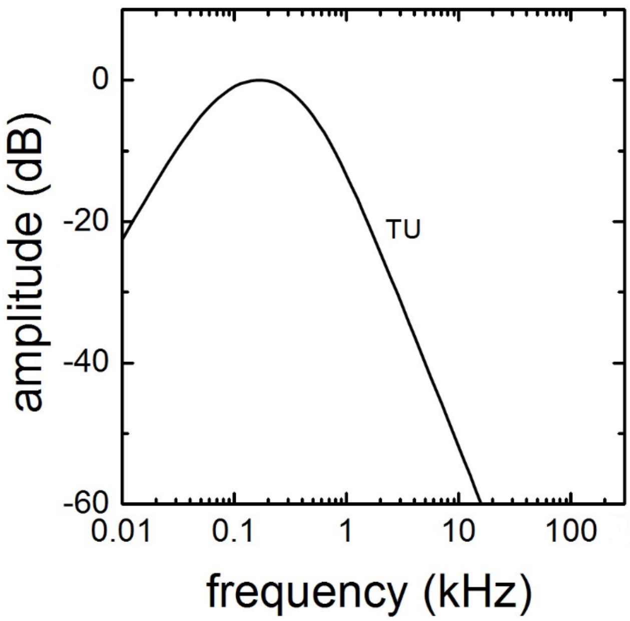
A further detailed explanation of this analysis is provided in the technical report titled *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2017b).

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

Auditory Weighting Functions

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

The auditory weighting function for sea turtles is shown in Figure 3.5-5. The derivation of this weighting function is described in the technical report *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (U.S. Department of the Navy, 2017a). The frequencies around the top portion of the function, where the amplitude is closest to zero, are emphasized, while the frequencies below and above this range (where amplitude declines) are de-emphasized, when summing acoustic energy received by a sea turtle.

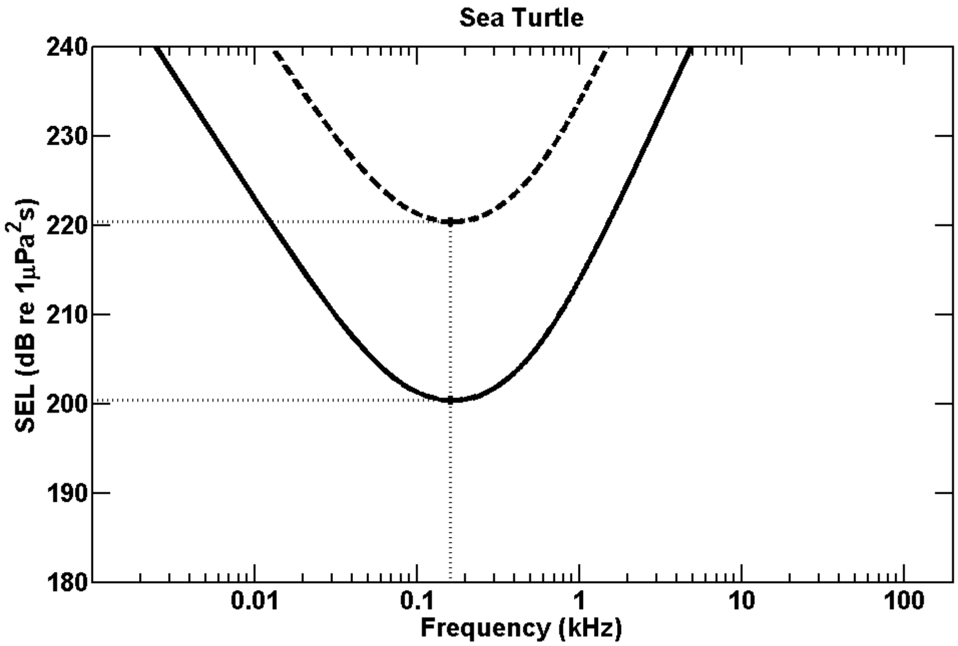


Source: U.S. Department of the Navy (2017a)
Notes: dB = decibels, kHz = kilohertz, TU = sea turtle species group

Figure 3.5-5: Auditory Weighting Function for Sea Turtles

Hearing Loss from Sonar and Other Transducers

No studies of hearing loss have been conducted on sea turtles. Therefore, sea turtle susceptibility to hearing loss due to an acoustic exposure is evaluated using knowledge about sea turtle hearing abilities in combination with non-impulsive auditory effect data from other species (marine mammals and fish). This yields sea turtle exposure functions, shown in Figure 3.5-6, which are mathematical functions that relate the sound exposure levels (SELs) for onset of TTS or PTS to the frequency of the sonar sound exposure. The derivation of the sea turtle exposure functions are provided in the technical report *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (U.S. Department of the Navy, 2017a).



Source: U.S. Department of the Navy (2017a)

Notes: dB re 1 μPa²s = decibels referenced to 1 micropascal second squared, kHz = kilohertz. The solid black curve is the exposure function for TTS and the dashed black curve is the exposure function for PTS onset. Small dashed lines and asterisks indicate the SEL thresholds at the most sensitive frequency for TTS (200 dB) and PTS (220 dB).

Figure 3.5-6: TTS and PTS Exposure Functions for Sonar and Other Transducers

Accounting for Mitigation

The Navy will implement mitigation measures to avoid or reduce potential impacts from active sonar on sea turtles, as described in Section 5.3.2.1 (Active Sonar). The benefits of mitigation are conservatively factored into the analysis for Alternative 1 and Alternative 2 of the Proposed Action for training and testing. The Navy's mitigation measures are identical for both action alternatives.

Procedural mitigation measures include a power down or shut down (i.e., power off) of applicable active sonar sources when a sea turtle is observed in a mitigation zone. The mitigation zones for active sonar activities were designed to avoid or reduce the potential for sea turtles to be exposed to levels of sound that could result in auditory injury (i.e., PTS) from active sonar to the maximum extent practicable. The mitigation zones encompass the estimated ranges to injury (including PTS) for a given sonar exposure. Therefore, the impact analysis quantifies the potential for mitigation to reduce the risk of PTS. Two factors are considered when quantifying the effectiveness of mitigation: (1) the extent to which the type of mitigation proposed for a sound-producing activity (e.g., active sonar) allows for observation of the mitigation zone prior to and during the activity; and (2) the sightability of each species that may be present in the mitigation zone, which is determined by species-specific characteristics and the viewing platform. A detailed explanation of the analysis is provided in the technical report *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2017b).

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

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

The Navy will also implement mitigation measures for certain active sonar activities within mitigation areas, as described in Appendix K (Geographic Mitigation Assessment). Mitigation areas are designed to help avoid or reduce impacts during biologically important life processes within particularly important habitat areas. The benefits of mitigation areas are discussed qualitatively in terms of the context of impact avoidance or reduction. Should national security present a requirement to conduct activities that the Navy would otherwise prohibit in a particular mitigation area, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include information about the event in its annual activity reports to NMFS.

3.5.2.1.2.2 Impact Ranges from Sonar and Other Transducers

Because sea turtle hearing range is limited to a narrow range of frequencies and thresholds for auditory impacts are relatively high, there are few sonar sources that could result in exposures exceeding the sea turtle TTS and PTS thresholds. The representative bin of LF4 for PTS is zero meters and for TTS is up to five meters for 120 seconds of exposure. Ranges would be greater (i.e., up to tens of meters) for sonars and other transducers with higher source levels (within their hearing range); however, specific ranges cannot be provided in an unclassified document.

3.5.2.1.2.3 Impacts from Sonar and Other Transducers Under Alternative 1

<u>Impacts from Sonar and Other Transducers Under Alternative 1 During Training Activities</u>

Leatherback turtles present in the Study Area may be exposed to sound from sonar and other transducers associated with training activities throughout the year. Leatherback turtles are highly migratory and lead a pelagic existence, and they tend to prefer foraging in productive offshore waters, such as waters off the coast of Washington and Oregon in the NWTT Offshore Area.

Sonar and other transducers emit sound waves into the water to detect objects, safely navigate, and communicate. General categories and characteristics of sonar systems and the number of hours these sonars would be operated during training activities under Alternative 1 are described in Section 3.0.3.1.1 (Sonar and Other Transducers). Activities using sonars and other transducers would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activities Descriptions). Overall use of sonar and other transducers in this Supplemental compared with the totals analyzed in the 2015 NWTT Final EIS/OEIS are described in Table 3.0-2.

Under Alternative 1, training activities would fluctuate each year to account for the natural variation of training cycles and deployment schedules. Some unit-level anti-submarine warfare training requirements would be met through synthetic training in conjunction with other training exercises. However, training activities using low-frequency sonar and other transducers within sea turtle hearing (< 2 kHz) will take place only in the NWTT Offshore Area, and would not fluctuate between years. Overall, use of sources in this frequency range are less common during training activities than testing activities, and occur less often than sources with higher frequency content.

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

The *ANSI Sound Exposure Guidelines* estimate that the risk of a sea turtle responding to a low-frequency sonar (less than 1 kHz) is low regardless of proximity to the source, and that there is no risk of a sea turtle responding to a mid-frequency sonar (1 to 10 kHz) (Popper et al., 2014). A sea turtle could respond to sounds detected within their limited hearing range if they are close enough to the source. The few studies of sea turtle reactions to sounds, discussed in Section 3.5.2.1.1.5 (Behavioral Reactions), suggest that a behavioral response could consist of temporary avoidance, increased swim speed, or changes in depth, or that there may be no observable response. Use of sonar and other transducers would typically be transient and temporary, and there is no evidence to suggest that any behavioral response would persist after a sound exposure. It is assumed that a stress response could accompany any behavioral response.

Implementation of mitigation may further reduce the already low risk of auditory impacts on sea turtles. Depending on the sonar source, mitigation includes powering down the sonar or ceasing active sonar transmission if a sea turtle is observed in the mitigation zone, as discussed in Section 3.5.2.1.2.1 (Methods for Analyzing Impacts from Sonar and Other Transducers – Accounting for Mitigation).

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

Designated leatherback turtle critical habitat, which includes the physical and biological features of leatherback turtle critical habitat (i.e., the occurrence of prey species, primarily jellyfish), overlaps the Study Area as described in Section 3.5.1.4 (Leatherback Sea Turtle [*Dermochelys coriacea*]). As discussed in Section 3.8.2.1.1 (Impacts from Sonar and Other Transducers) of the Marine Invertebrates section, impacts to marine invertebrates (e.g., jellyfish) from acoustic stressors (i.e., sonar and other transducers) would be insignificant. As a result, activities would not prevent a turtle from feeding as these activities are not continuous and most active sources are outside of sea turtle and prey species hearing range (as described in the 2015 NWTT Final EIS/OEIS Section 3.8.2.2, Invertebrate Hearing and Vocalization). Only jellyfish in very close proximity to low-frequency sources could be exposed for a short duration, however, these exposures would not affect the overall prey availability for leatherback turtles. Impacts to prey species, if any, would be minimal, thus sonar and other transducers would have no discernable impact on the condition, distribution, diversity, and abundance and density of prey species necessary to support individual as well as population growth, reproduction, and development of leatherback turtles in the Study Area.

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

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 1 would have no effect on leatherback turtle critical habitat, but may affect the ESA-listed leatherback turtle. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA.

Impacts from Sonar and Other Transducers Under Alternative 1 During Testing Activities

Leatherback turtles present in the Study Area may be exposed to sound from sonar and other transducers associated with testing activities throughout the year. Leatherback turtles are highly migratory and lead a pelagic existence, and they tend to prefer foraging in productive offshore waters, such as waters off the coast of Washington and Oregon in the NWTT Offshore Area.

General categories and characteristics of sonar systems and the number of hours these sonars would be operated during testing under Alternative 1 are described in Section 3.0.3.1.1 (Sonar and Other Transducers). Activities using sonars and other transducers would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activities Descriptions). Overall use of sonar and other transducers in this Supplemental compared with the totals analyzed in the 2015 NWTT Final EIS/OEIS are described in Table 3.0-2.

Under Alternative 1, testing activities would fluctuate each year to account for the natural variation of testing cycles and deployment schedules. Testing activities using low-frequency sonar and other transducers within sea turtle hearing (< 2 kHz) would take place throughout the NWTT Study Area, and would fluctuate very little between years. The use of sources in this frequency range are more common during testing activities than training activities; however, these sources would occur more frequently in the NWTT Inland Waters, where leatherback turtles typically do not occupy. The general impacts from sonar and other transducers during testing would be similar in severity to those described during training. In addition, some new systems using new technologies would be tested under Alternative 1.

The quantitative analysis, using the number of hours of sonar and other transducers for a maximum year of testing activities under Alternative 1, predicts that no leatherback turtles are likely to be exposed to the high received levels of sound from sonars or other transducers that could cause TTS or PTS.

The *ANSI Sound Exposure Guidelines* estimate that the risk of a sea turtle responding to a low-frequency sonar (less than 1 kHz) is low regardless of proximity to the source, and that there is no risk of a sea turtle responding to a mid-frequency sonar (1 to 10 kHz) (Popper et al., 2014). A sea turtle could respond to sounds detected within their limited hearing range if they are close enough to the source. The few studies of sea turtle reactions to sounds, discussed in Section 3.5.2.1.1.5 (Behavioral Reactions), suggest that a behavioral response could consist of temporary avoidance, increased swim speed, or changes in depth, or that there may be no observable response. Use of sonar and other transducers would typically be transient and temporary. There is no evidence to suggest that any behavioral response would persist after a sound exposure. It is assumed that a stress response could accompany any behavioral response.

Implementation of mitigation may further reduce the already low risk of auditory impacts on sea turtles. Depending on the sonar source, mitigation includes powering down the sonar or ceasing active sonar transmission if a sea turtle is observed in the mitigation zone, as discussed in Section 3.5.2.1.2.1 (Methods for Analyzing Impacts from Sonar and Other Transducers – Accounting for Mitigation).

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

Designated leatherback turtle critical habitat, which includes the physical and biological features of leatherback turtle critical habitat (i.e., the occurrence of prey species, primarily jellyfish), overlaps the Study Area as described in Section 3.5.1.4 (Leatherback Sea Turtle [*Dermochelys coriacea*]). As discussed in Section 3.8.2.1.1 (Impacts from Sonar and Other Transducers) of the Marine Invertebrates section, impacts to marine invertebrates (e.g., jellyfish) from acoustic stressors (i.e., sonar and other transducers) would be insignificant. As a result, activities would not prevent a turtle from feeding as these activities are not continuous and most active sources are outside of sea turtle and prey species hearing range (as described in the 2015 NWTT Final EIS/OEIS Section 3.8.2.2, Invertebrate Hearing and Vocalization). Only jellyfish in very close proximity to low-frequency sources could be exposed for a short duration, however, these exposures would not affect the overall prey availability for leatherback turtles. Additionally, sonar sources used during testing activities would occur more frequently in the NWTT Inland Waters, where leatherback turtles typically do not occupy. Impacts to prey species, if any, would be minimal, thus sonar and other transducers would have no discernible impact on the condition, distribution, diversity, and abundance and density of prey species necessary to support individual as well as population growth, reproduction, and development of leatherback turtles in the Study Area.

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

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 1 would have no effect on leatherback turtle critical habitat, but may affect the ESA-listed leatherback turtle. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA.

3.5.2.1.2.4 Impacts from Sonar and Other Transducers Under Alternative 2

Impacts from Sonar and Other Transducers Under Alternative 2 During Training Activities

Leatherback turtles present in the Study Area may be exposed to sound from sonar and other transducers associated with training activities throughout the year. Leatherback turtles are highly migratory and lead a pelagic existence, and they tend to prefer foraging in productive offshore waters, such as waters off the coast of Washington and Oregon in the NWTT Offshore Area.

As described in Chapter 2 (Description of Proposed Action and Alternatives), Section 3.0.3.1.1 (Sonar and Other Transducers), and Appendix A (Navy Activities Descriptions), training activities under Alternative 2 reflect the maximum number of activities that could occur within a given year. This would result in an overall increase in sonar use compared to Alternative 1, however the hours of sonar and other transducers use in sea turtle hearing range (< 2,000 Hz) would remain the same between Alternative 1 and 2, and would still only occur in the NWTT Offshore Area. Overall, use of sources in this frequency range are less common during training activities than testing activities, and occur less often than sources with higher frequency content.

The quantitative analysis, using the number of hours of sonar and other transducers for a maximum year of training activities under Alternative 2, predicts that no leatherback turtles are likely to be exposed to the high received levels of sound from sonars or other transducers that could cause TTS or PTS.

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

Pursuant to the ESA, the use of sonar and other transducers during training activities as described under Alternative 2 would have no effect on leatherback turtle critical habitat, but may affect the ESA-listed leatherback turtle.

Impacts from Sonar and Other Transducers Under Alternative 2 During Testing Activities

Leatherback turtles present in the Study Area may be exposed to sound from sonar and other transducers associated with testing activities throughout the year. Leatherback turtles are highly migratory and lead a pelagic existence, and they tend to prefer foraging in productive offshore waters, such as waters off the coast of Washington and Oregon in the NWTT Offshore Area.

As described in Chapter 2 (Description of Proposed Action and Alternatives), Section 3.0.3.1.1 (Sonar and Other Transducers), and Appendix A (Navy Activities Descriptions), testing activities under Alternative 2 reflects the maximum number of activities that could occur within a given year. This would result in an overall increase in sonar use compared to Alternative 1, including sources within sea turtle hearing range (<2,000 Hz). However, the locations, types, and severity of predicted impacts would be similar to those described above in Section 3.5.2.1.2.3 (Impacts from Sonar and Other Transducers Under Alternative 1). The hours of use of sonars and other transducers in this Supplemental compared with the totals analyzed in the 2015 NWTT Final EIS/OEIS are described in Table 3.0-2.

Under Alternative 2, testing activities using low-frequency sonar and other transducers would take place throughout the NWTT Study Area; however, these sources would occur more frequently in the NWTT Inland Waters, where leatherback turtles typically do not occupy. The general impacts from sonar and other transducers during testing would be similar in severity to those described during training. Same as Alternative 1, some new systems using new technologies would be tested under Alternative 2.

The quantitative analysis, using the number of hours of sonar and other transducers for a maximum year of testing activities under Alternative 2, predicts that no leatherback turtles are likely to be exposed to the high received levels of sound from sonars or other transducers that could cause TTS or PTS.

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

Pursuant to the ESA, the use of sonar and other transducers during testing activities as described under Alternative 2 would have no effect on leatherback turtle critical habitat, but may affect the ESA-listed leatherback turtle.

3.5.2.1.2.5 Impacts from Sonar and Other Transducers Under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct proposed at-sea training and testing activities in the Study Area. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

Discontinuing the training and testing activities would result in fewer acoustic stressors (e.g., sonar and other transducers) within the marine environment where activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would lessen the potential for impacts from sonar and other transducers on sea turtles, but would not measurably improve the overall distribution or abundance of sea turtles.

3.5.2.1.3 Impacts from Vessel Noise

Sea turtles may be exposed to noise from vessel movement. A detailed description of the acoustic characteristics and typical sound levels of vessel noise are in Section 3.0.3.1.2 (Vessel Noise). Vessel movements involve transits to and from ports to various locations within the Study Area, including commercial ship traffic as well as recreational vessels in addition to U.S. Navy vessels. 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).

Section 3.5.2.1.1 (Background) summarizes and synthesizes available information on behavioral reactions, masking, and physiological stress due to noise exposure, including vessel noise (Sections 3.5.2.1.1.2, Hearing Loss; 3.5.2.1.1.3, Physiological Stress; 3.5.2.1.1.4, Masking; and 3.5.2.1.1.5, Behavioral Reactions).

Activities may vary slightly from those previously analyzed in the 2015 NWTT Final EIS/OEIS, but the overall determinations presented remain valid. Increases and decreases shown in Tables 2.5-1 and 2.5-2 for proposed training and testing activities under Alternative 1 and 2 do not appreciably change the impact conclusions presented in the 2015 NWTT Final EIS/OEIS.

Under the No Action Alternative, the Navy would not conduct proposed at-sea training and testing activities in the Study Area. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

Discontinuing the training and testing activities would result in fewer acoustic stressors (e.g., vessel noise) within the marine environment where activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would lessen the potential for impacts from vessel noise on sea turtles, but would not measurably improve the overall distribution or abundance of sea turtles.

Pursuant to the ESA, vessel noise during training and testing activities, as described under Alternative 1 and Alternative 2, would have no effect on leatherback turtle critical habitat, but may affect ESA-listed leatherback turtles. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA for Alternative 1.

3.5.2.1.4 Impacts from Aircraft Noise

Sea turtles may be exposed to aircraft-generated noise throughout the Study Area. Fixed- and rotary-wing aircraft are used during a variety of training and testing activities throughout the Study Area. Tilt-rotor impacts would be similar to fixed-wing or helicopter impacts depending on the mode of the aircraft. In the Offshore Area where sea turtles occur, helicopter movement would be concentrated around ships and fixed-wing movement would be concentrated in Special Use Airspace. Aircraft produce extensive airborne noise from either turbofan or turbojet engines. An 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).

A detailed description of aircraft noise as a stressor is in Section 3.0.3.1.3 (Aircraft Noise). Activities may vary slightly from those previously analyzed in the 2015 NWTT Final EIS/OEIS, but the overall determinations presented remain valid. Increases and decreases shown in Tables 2.5-1, 2.5-2, and 2.5-3 for proposed training and testing activities under Alternative 1 and 2 do not appreciably change the impact conclusions presented in the 2015 NWTT Final EIS/OEIS.

Under the No Action Alternative, the Navy would not conduct proposed at-sea training and testing activities in the Study Area. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

Discontinuing the training and testing activities would result in fewer acoustic stressors (e.g., aircraft noise) within the marine environment where activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would lessen the potential for impacts from aircraft noise on sea turtles, but would not measurably improve the overall distribution or abundance of sea turtles.

Pursuant to the ESA, aircraft noise during training and testing activities as described under Alternative 1 and Alternative 2, would have no effect on leatherback turtle critical habitat, but may affect ESA-listed leatherback turtles. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA for Alternative 1.

3.5.2.1.5 Impacts from Weapon Noise

Sea turtles may be exposed to sounds caused by the firing of weapon, objects in flight, and impact of non-explosive munitions on the water's surface, which are described in Section 3.0.3.1.4 (Weapons Noise). In general, these are impulsive sounds generated in close vicinity to or at the water surface, with the exception of items that are launched underwater. The firing of a weapon may have several components of associated noise. Firing of guns could include sound generated in air by firing a gun (muzzle blast) and a crack sound due to a low amplitude shock wave generated by a supersonic projectile flying through the air. Most in-air sound would be reflected at the air-water interface.

Underwater sounds would be strongest just below the surface and directly under the firing point. Any sound that enters the water only does so within a narrow cone below the firing point or path of the projectile. Vibration from the blast propagating through a ship’s hull, the sound generated by the impact of an object with the water surface, and the sound generated by launching an object underwater are other sources of impulsive sound in the water. Sound due to missile and target launches is typically at a maximum at initiation of the booster rocket and rapidly fades as the missile or target travels downrange.

Activities may vary slightly from those previously analyzed in the 2015 NWTT Final EIS/OEIS, but the overall determinations presented remain valid. Increases and decreases shown in Tables 2.5-1 and 2.5-2 for proposed training and testing activities under Alternative 1 and 2 do not appreciably change the impact conclusions presented in the 2015 NWTT Final EIS/OEIS. Implementation of mitigation may further reduce the already low risk of auditory impacts on sea turtles from weapon noise during large-caliber gunnery events, as discussed in Section 5.3.2.2 (Weapons Firing Noise).

Under the No Action Alternative, the Navy would not conduct proposed at-sea training and testing activities in the Study Area. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

Discontinuing the training and testing activities would result in fewer acoustic stressors (e.g., weapon noise) within the marine environment where activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would remove the potential for impacts from weapon noise on sea turtles, but would not measurably improve the overall distribution or abundance of sea turtles.

Pursuant to the ESA, weapon noise during training and testing activities as described under Alternative 1 and Alternative 2, would have no effect on leatherback turtle critical habitat, but may affect ESA-listed leatherback turtles. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA for Alternative 1.

3.5.2.2 Explosive Stressors

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

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

This section begins with a summary of relevant data regarding explosive impacts on sea turtles in Section 3.5.2.2.1 (Background). The ways in which an explosive exposure could result in immediate effects or lead to long-term consequences for an animal are explained in Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Stressors), and this section follows that framework. Studies of the effects of sound and explosives on sea turtles are limited; therefore, where necessary, knowledge of impacts on other species from explosives is used to assess impacts on sea turtles.

Due to new acoustic impact criteria, sea turtle densities, and revisions to the Navy Acoustic Effects Model, the analysis provided in Section 3.5.2.2.2 (Impacts from Explosives) of this Supplemental will supplant the 2015 NWTT Final EIS/OEIS for sea turtles, and may result in changes to estimated impacts since the 2015 NWTT Final EIS/OEIS.

3.5.2.2.1 Background

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

3.5.2.2.1.1 Injury

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

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

See Appendix D (Acoustic and Explosive Concepts) for an overview of explosive propagation and an explanation of explosive effects on gas cavities.

Primary blast injury is injury that results from the compression of a body exposed to a blast wave. This is usually observed as barotrauma of gas-containing structures (e.g., lung and gut) and structural damage to the auditory system (Greaves et al., 1943; Office of the Surgeon General, 1991; Richmond et al., 1973). The lungs are typically the first site to show any damage, while the solid organs (e.g., liver, spleen, and kidney) are more resistant to blast injury (Clark & Ward, 1943). Recoverable injuries would include slight lung injury, such as capillary interstitial bleeding, and contusions to the gastrointestinal tract. More severe injuries would significantly reduce fitness and likely cause death in the wild. Rupture of the lung may also introduce air into the vascular system, producing air emboli that can cause a stroke or heart attack by restricting oxygen delivery to critical organs. In this discussion, primary blast injury to auditory tissues is considered gross structural tissue injury distinct from noise-induced hearing loss, which is considered below in Section 3.5.2.2.1.2 (Hearing Loss).

Data on observed injuries to sea turtles from explosives is generally limited to animals found following explosive removal of offshore structures (Viada et al., 2008), which can attract sea turtles for feeding opportunities or shelter. Klima et al. (1988) observed a turtle mortality subsequent to an oil platform removal blast, although sufficient information was not available to determine the animal’s exposure. Klima et al. (1988) also placed small sea turtles (less than 7 kilograms) at varying distances from piling detonations. Some of the turtles were immediately knocked unconscious or exhibited vasodilation over the following weeks, but others at the same exposure distance exhibited no effects.

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

Results from limited experimental data suggest two explosive metrics are predictive of explosive injury: peak pressure and impulse.

Impulse as a Predictor of Explosive Injury

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

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

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

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

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

Peak Pressure as a Predictor of Explosive Trauma

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

Older military reports documenting exposure of human divers to blast exposure generally describe peak pressure exposures around 100 lb. psi (237 dB re 1 µPa peak) to feel like a slight pressure or stinging sensation on skin, with no enduring effects (Christian & Gaspin, 1974). Around 200 psi, the shock wave felt like a blow to the head and chest. Data from the Lovelace Foundation experiments show instances of gastrointestinal tract contusions after exposures up to 1147 psi peak pressure, while exposures of up to 588 psi peak pressure resulted in many instances of no observed gastrointestinal tract effects. The lowest exposure for which slight contusions to the gastrointestinal tract were reported was 237 dB re 1 µPa peak. As a vulnerable gas-containing organ, the gastrointestinal tract is vulnerable to both high peak pressure and high impulse, which may vary to differing extents due to blast exposure conditions (i.e., animal depth, distance from the charge). This likely explains the range of effects seen at similar peak pressure exposure levels and shows the utility of considering both peak pressure and impulse when analyzing the potential for injury due to explosives.

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

3.5.2.2.1.2 Hearing Loss

An underwater explosion produces broadband, impulsive sound that can cause noise-induced hearing loss, typically quantified as threshold shift, which persists after cessation of the noise exposure. This noise-induced hearing loss may manifest as TTS or PTS. Because studies on inducing threshold shift in sea turtles are very limited (e.g., alligator lizards: Dew et al., 1993; Henry & Mulroy, 1995) and have not been conducted on any of the sea turtles present in the Study Area, auditory threshold shift in sea turtles is considered to be consistent with general knowledge about noise-induced hearing loss described in Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities).

Little is known about how sea turtles use sound in their environment. The ANSI Sound Exposure Guidelines (Popper et al., 2014) do not suggest numeric sound exposure thresholds for auditory effects on sea turtles due to lack of data. Rather, the guidelines qualitatively advise that sea turtles are less likely to incur TTS or PTS with increasing distance from an explosive. The guidelines also suggest that data from fishes may be more relevant than data from marine mammals when estimating auditory impacts on sea turtles, because, in general, fish hearing range is more similar to the limited hearing range of sea turtles. As shown in Section 3.5.1.2 (Hearing and Vocalization), sea turtle hearing is most sensitive around 100–400 Hz in-water, is limited over 1 kHz, and is much less sensitive than that of any marine mammal.

3.5.2.2.1.3 Physiological Stress

A stress response is a suite of physiological changes that are meant to help an organism mitigate the impact of a stressor. If the magnitude and duration of the stress response is too great or too long, it can have negative consequences to the animal (e.g., decreased immune function, decreased reproduction). Physiological stress is typically analyzed by measuring stress hormones, other biochemical markers, or vital signs. Physiological stress has been measured for sea turtles during nesting (Flower et al., 2015; Valverde et al., 1999) and capture and handling (Flower et al., 2015; Gregory & Schmid, 2001), but the stress caused by acoustic exposure has not been studied for sea turtles. Therefore, the stress response in sea turtles in the Study Area due to acoustic exposures is considered to be consistent with general knowledge about physiological stress responses described in Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities).

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

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

3.5.2.2.1.4 Masking

As described in Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities), auditory masking occurs when one sound, distinguished as the “noise,” interferes with the detection or recognition of another sound or limits the distance over which other biologically relevant sounds can be detected. Masking only occurs when the sound source is operating; therefore, direct masking effects stop immediately upon cessation of the sound-producing activity. Any unwanted sound above ambient noise and within an animal’s hearing range may potentially cause masking which can interfere with an animal’s ability to detect, understand, or recognize biologically relevant sounds of interest.

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

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

3.5.2.2.1.5 Behavioral Reactions

There are no observations of behavioral reactions by sea turtles to exposure to explosive sounds. Impulsive signals, particularly at close range, have a rapid rise time and higher instantaneous peak pressure than other signal types, making them more likely to cause startle responses or avoidance responses. Although explosive sources are more energetic than air guns, the few studies of sea turtles' responses to air guns, which are not used during Navy training or testing activities, may show the types of behavioral responses that sea turtles may have towards explosives. General research findings regarding behavioral reactions from sea turtles due to exposure to impulsive sounds, such as those associated with explosions, are discussed in detail in Behavioral Reactions to Impulsive Sound Sources under Section 3.5.2.1 (Acoustic Stressors).

3.5.2.2.1.6 Long-Term Consequences

For sea turtles present in the Study Area, long-term consequences to individuals and populations due to acoustic exposures have not been studied. Therefore, long-term consequences to sea turtles due to explosive exposures are considered following Section 3.0.3.7 (Conceptual Framework for Assessing Effects from Acoustic and Explosive Activities).

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

3.5.2.2.2 Impacts from Explosives

Sea turtles could be exposed to energy, sound, and fragments from explosions in the water and near the water surface associated with the proposed activities. Energy and sound from an explosion are capable of causing mortality, injury, hearing loss, a behavioral response, masking, or physiological stress, depending on the level and duration of exposure. The death of an animal would eliminate future reproductive potential, which is considered in the analysis of potential long-term consequences to the population. Exposures that result in non-auditory injuries may limit an animal's ability interpret the surrounding environment. Impairment of these abilities can decrease an individual's chance of survival or affect its ability to reproduce. Temporary threshold shift can also impair an animal's abilities, although the individual may recover quickly with little significant effect.

Overall, the locations, types, and severity of predicted impacts for the use of explosives during training and testing activities would be similar to what is currently conducted, with the addition of a new testing activity described in Table 2.5-1 and 2.5-2. The activities that use explosive munitions would occur in the same general locations and in a similar manner as previously analyzed in the 2015 NWTT Final EIS/OEIS, with one exception. A new mine countermeasure and neutralization testing activity would occur in the Offshore Area approximately two times per year and would use explosives within the water column (see Chapter 2, Description of Proposed Action and Alternatives). Although activities may vary in the number of events or ordnances from those previously analyzed, the overall determinations presented in the 2015 NWTT Final EIS/OEIS remain valid (with the exception of leatherback turtle Critical Habitat), and has been developed further under this Supplemental.

The quantitative analysis has been updated since the 2015 NWTT Final EIS/OEIS; therefore, the following analysis is written in full to reflect the new criteria and thresholds, as described in the technical report *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2017b).

3.5.2.2.2.1 Methods for Analyzing Impacts from Explosives

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

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

A further detailed explanation of this analysis is provided in the technical report titled *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2017b).

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

Mortality and Injury from Explosives

As discussed above in Section 3.5.2.2.1.1 (Injury), two metrics have been identified as predictive of injury: impulse and peak pressure. Peak pressure contributes to the "crack" or "stinging" sensation of a blast wave, compared to the "thump" associated with received impulse. Older military reports documenting exposure of human divers to blast exposure generally describe peak pressure exposures around 100 psi (237 dB re 1 µPa SPL peak) to feel like slight pressure or stinging sensation on skin, with no enduring effects (Christian & Gaspin, 1974).

Two sets of thresholds are provided for use in non-auditory injury assessment. The exposure thresholds are used to estimate the number of animals that may be affected during Navy training and testing activities (Table 3.5-1). The thresholds for the farthest range to effect are based on the received level at which one percent risk is predicted and are useful for assessing potential effects to sea turtles and marine mammals, and the range at which mitigation could be effective. Increasing animal mass and increasing animal depth both increase the impulse thresholds (i.e., decrease susceptibility), whereas smaller mass and decreased animal depth reduce the impulse thresholds (i.e., increase susceptibility). For impact assessment, sea turtle populations are assumed to be 5 percent adult and 95 percent sub-adult. This adult to sub-adult population ratio is estimated from what is known about the population age structure for sea turtles. Sea turtles typically lay multiple clutches of 100 or more eggs with little parental investment and generally have low survival in early life. However, sea turtles that are able to survive past early life generally have high age-specific survival in later life.

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

Table 3.5-1: Criteria to Quantitatively Assess Non-Auditory Injury due to Underwater Explosions

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

[1] Impulse delivered over 20% of the estimated lung resonance period. See U.S. Department of the Navy (2017a).
[2] Threshold for one percent risk used to assess mitigation effectiveness.
Note: dB re 1 µPa = decibels referenced to 1 micropascal, SPL = sound pressure level, M = animal mass (kg), D = animal depth (m), and Pa-s = Pascal-second

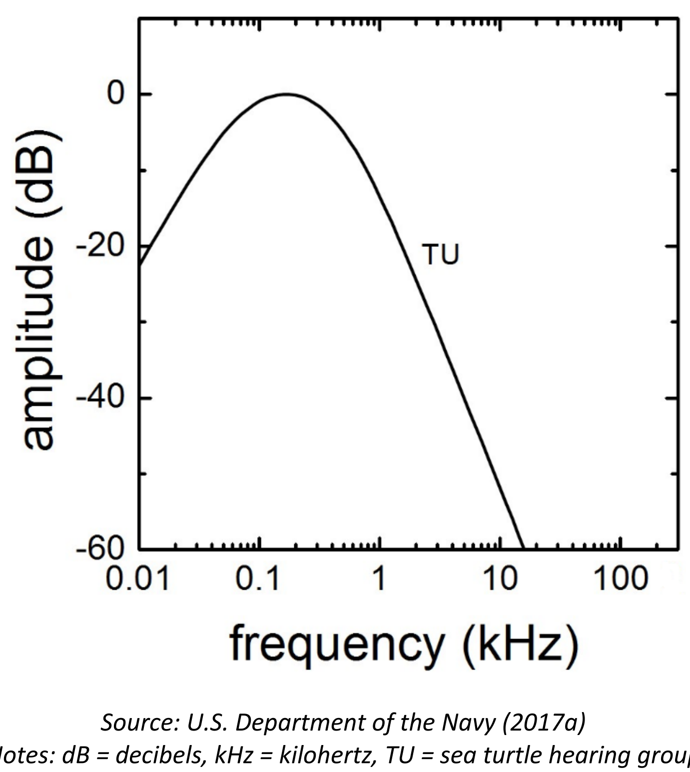
When explosive munitions (e.g., a bomb or missile) detonates, fragments of the weapon are thrown at high-velocity from the detonation point, which can injure or kill sea turtles if they are struck. Risk of fragment injury reduces exponentially with distance as the fragment density is reduced. Fragments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

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

Auditory Weighting Functions

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

The auditory weighting function for sea turtles is shown in Figure 3.5-7. The derivation of this weighting function is described in the technical report *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (U.S. Department of the Navy, 2017a). The frequencies around the top portion of the function, where the amplitude is closest to zero, are emphasized, while the frequencies below and above this range (where amplitude declines) are de-emphasized, when summing acoustic energy received by a sea turtle.



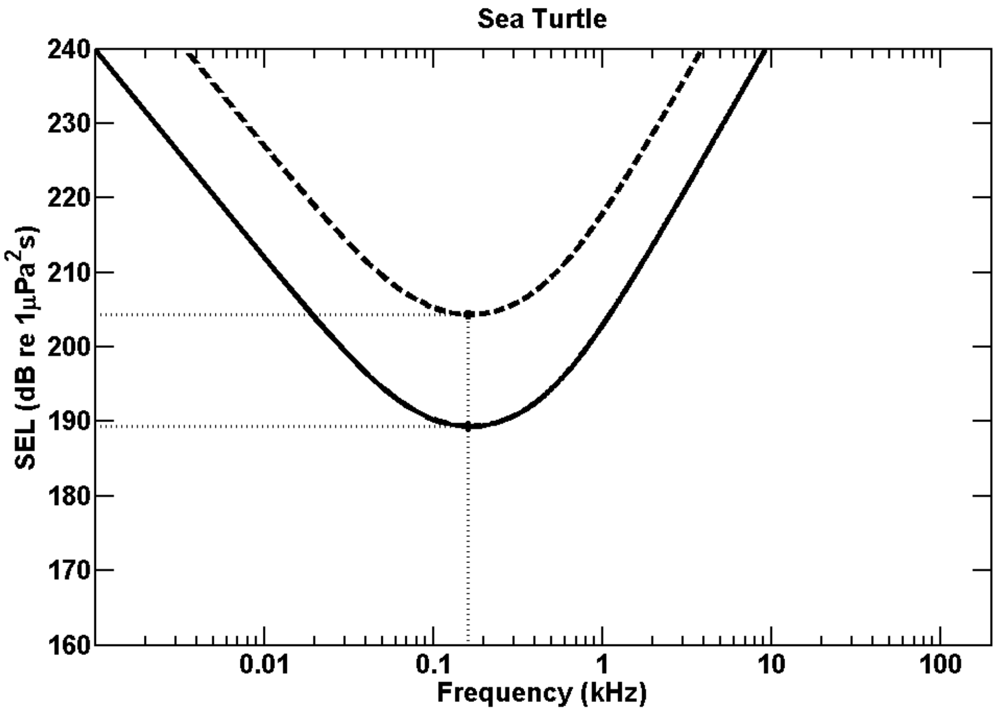
Source: U.S. Department of the Navy (2017a)
Notes: dB = decibels, kHz = kilohertz, TU = sea turtle hearing group

Figure 3.5-7: Auditory Weighting Functions for Sea Turtles

Hearing Loss from Explosives

No studies of hearing loss have been conducted on sea turtles. Therefore, sea turtle susceptibility to hearing loss due to an acoustic exposure is evaluated using knowledge about sea turtle hearing abilities in combination with non-impulsive auditory effect data from other species (marine mammals and fish). This yields sea turtle exposure functions, shown in Figure 3.5-8, which are mathematical functions that relate the SELs for onset of TTS or PTS

to the frequency of the sonar sound exposure. The derivation of the sea turtle exposure functions are provided in the technical report *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (U.S. Department of the Navy, 2017a).



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

Figure 3.5-8: TTS and PTS Exposure Functions for Impulsive Sounds

For impulsive sounds, hearing loss in other species has also been observed to be related to the unweighted peak pressure of a received sound. Because this data does not exist for sea turtles, unweighted peak pressure thresholds for TTS and PTS were developed by applying relationships observed between impulsive peak pressure TTS thresholds and auditory sensitivity in marine mammals to sea turtles. This results in dual-metric hearing loss criteria for sea turtles for impulsive sound exposure: the SEL-based exposure functions in Figure 3.5-8 and the peak pressure thresholds in Table 3.5-2. The derivation of the sea turtle impulsive peak pressure TTS and PTS thresholds are provided in the technical report *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (U.S. Department of the Navy, 2017a).

Table 3.5-2: TTS and PTS Peak Pressure Thresholds Derived for Sea Turtles Exposed to Impulsive Sounds

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

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

Accounting for Mitigation

The Navy will implement mitigation measures to avoid or reduce potential impacts from explosives on sea turtles, as described in Section 5.3.3 (Explosive Stressors). The benefits of mitigation are conservatively factored into the analysis for Alternative 1 and Alternative 2 of the Proposed Action for training and testing. The Navy's mitigation measures are identical for both action alternatives.

Procedural mitigation measures include delaying or ceasing applicable detonations when a sea turtle is observed in a mitigation zone. The mitigation zones for explosives extend beyond the respective average ranges to mortality. The mitigation zones encompass the estimated ranges to mortality for a given explosive. Therefore, the impact analysis quantifies the potential for mitigation to reduce the risk of mortality due to exposure to explosives. Two factors are considered when quantifying the effectiveness of mitigation: (1) the extent to which the type of mitigation proposed for a sound-producing activity (e.g., active sonar) allows for observation of the mitigation zone prior to and during the activity; and (2) the sightability of each species that may be present in the mitigation zone, which is determined by species-specific characteristics and the viewing platform. A detailed explanation of the analysis is provided in the technical report *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing* (U.S. Department of the Navy, 2017b).

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

The Navy will also implement mitigation measures for explosive activities within mitigation areas, as described in Appendix K (Geographic Mitigation Assessment). Mitigation areas are designed to help avoid or reduce impacts during biologically important life processes within particularly important habitat areas. The benefits of mitigation areas are discussed qualitatively in terms of the context of impact avoidance or reduction. Should national security present a requirement to conduct activities that the Navy would otherwise prohibit in a particular mitigation area, naval units will obtain permission from the appropriate designated Command authority prior to commencement of the activity. The Navy will provide NMFS with advance notification and include information about the event in its annual activity reports to NMFS.

3.5.2.2.2.2 Impact Ranges from Explosives

The following section provides the range (distance) over which specific physiological or behavioral effects are expected to occur based on the explosive criteria and the explosive propagation calculations from the Navy Acoustic Effects Model (Section 3.5.2.2.2.1, Methods for Analyzing Impacts from Explosives). The range to effects is shown for a range of explosive bins, from E1 (up to 0.25 lb. net explosive weight) to E11 (greater than 500 lb.–650 lb. net explosive weight). Ranges are determined by modeling the distance that noise from an explosion will need to propagate to reach exposure level thresholds specific to a hearing group that will cause TTS, PTS, non-auditory injury, and mortality. Range to effects is important information in not only predicting impacts from explosives, but also in verifying the accuracy of model results against real-world situations and assessing the level of impact that will be mitigated within applicable mitigation zones.

Table 3.5-3 shows the minimum, average, and maximum ranges due to varying propagation conditions to non-auditory injury based on the larger of the range to slight lung injury or gastrointestinal tract injury for representative animal masses ranging from 250 to 1,000 kg and different explosive bins ranging from 0.25 to 650 lb. net explosive weight. Animals within these water volumes would be expected to receive minor injuries at the outer ranges, increasing to more substantial injuries, and finally mortality as an animal approaches the detonation point. Ranges to mortality, based on animal mass, are shown in Table 3.5-4.

The following tables (Table 3.5-5 and Table 3.5-6) show the minimum, average, and maximum ranges to onset of auditory and behavioral effects based on the thresholds described in Section 3.5.2.2.2.1 (Methods for Analyzing Impacts from Explosives – Criteria and Thresholds Used to Predict Impacts on Sea Turtles from Explosives). Ranges are provided for a representative source depth and cluster size (the number of rounds fired [or buoys dropped] within a very short duration) for each bin. For events with multiple explosions, sound from successive explosions can be expected to accumulate and increase the range to the onset of an impact based on SEL thresholds. Modeled ranges to TTS and PTS based on peak pressure for a single explosion generally exceed the modeled ranges based on SEL even when accumulated for multiple explosions. Peak pressure-based ranges are estimated using the best available science; however, data on peak pressure at far distances from explosions are very limited. For additional information on how ranges to impacts from explosions were estimated, see the technical report *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing Ranges* (U.S. Department of the Navy, 2017b).

Table 3.5-3: Ranges to Non-Auditory Injury[1] (in meters) for Sea Turtles Exposed to Explosives as a Function of Animal Mass

Bin[2]	Ranges to Non-Auditory Injury (m)[1]	
	Animal Mass of 250 kg	Animal Mass of 1,000 kg
E1	12 (11–13)	12 (11–13)
E2	16 (15–16)	16 (15–16)
E3	25 (25–45)	25 (25–45)
E4	31 (30–50)	31 (30–50)
E5	40 (40–40)	40 (40–40)
E7	79 (75–120)	79 (75–120)
E8	93 (90–110)	93 (90–110)
E10	155 (150–160)	155 (150–160)
E11	247 (190–270)	174 (170–260)

[1]Average distance (m) to non-auditory injury is depicted above the minimum and maximum distances which are in parentheses. The ranges depicted are the further of the ranges for gastrointestinal tract injury or slight lung injury for an explosive bin and animal mass interval combination.
[2]Bin (net explosive weight, lb.): E1 (0.1–0.25), E2 (> 0.25–0.5), E3 (> 0.5–2.5), E4 (> 2.5–5), E5 (> 5–10), E7 (> 20–60), E8 (> 60–100), E10 (> 250–500), E11 (> 500–650)
Note: kg = kilogram(s)

Table 3.5-4: Ranges to Mortality (in meters) for Sea Turtles Exposed to Explosives as a Function of Animal Mass[1]

Bin[2]	*Ranges to Mortality (m)*	
	Animal Mass of 250 kg[1]	*Animal Mass of 1,000 kg[1]*
E1	1 (1–1)	0 (0–0)
E2	2 (2–3)	1 (1–1)
E3	6 (6–10)	2 (2–5)
E4	8 (7–9)	4 (4–5)
E5	8 (7–8)	4 (3–4)
E7	29 (25–35)	16 (14–20)
E8	40 (40–40)	21 (21–21)
E10	27 (25–30)	16 (16–17)
E11	96 (70–100)	49 (45–50)

[1]Average distance (m) to mortality is depicted above the minimum and maximum distances which are in parentheses.
[2]Bin (net explosive weight, lb.): E1 (0.1–0.25), E2 (> 0.25–0.5), E3 (> 0.5–2.5), E4 (> 2.5–5), E5 (> 5–10), E7 (> 20–60), E8 (> 60–100), E10 (> 250–500), E11 (> 500–650)

Table 3.5-5: Peak Pressure Based Ranges to TTS and PTS (in meters) for Sea Turtles Exposed to Explosives

Range to Effects for Explosives Bin: Sea turtles[1]			
***Bin*[2]**	***Source Depth (meters)***	***Range to PTS (meters)*[1]**	***Range to TTS (meters)*[1]**
E1	0.1	37 (35—40)	69 (65—70)
E2	0.1	48 (45—50)	88 (80—90)
E3[3]	18.25 Offshore Area	80 (80—85)	154 (150—200)
E4	10	100 (100—100)	190 (190—190)
	30	105 (100—140)	262 (190—675)
	70	106 (100—160)	206 (190—350)
	90	103 (100—150)	197 (190—320)
E5	0.1	128 (120—130)	243 (230—250)
E7	10	255 (250—260)	471 (440—500)
	30	419 (240—1,025)	722 (440—1,025)
E8	45.75	434 (280—975)	956 (525—2,025)
E10	0.1	481 (470—490)	863 (850—875)
E11	91.4	929 (525—1,775)	2,122 (1,000—3,775)
	200	563 (525—800)	1,606 (1,000—3,525)

[1]Distances in meters (m). Average distance is shown with the minimum and maximum distances due to varying propagation environments in parentheses.
[2]Bin (net explosive weight, lb.): E1 (0.1–0.25), E2 (> 0.25–0.5), E3 (> 0.5–2.5), E4 (> 2.5–5), E5 (> 5–10), E7 (> 20–60), E8 (> 60–100), E10 (> 250–500), E11 (> 500–650)
Notes: PTS = permanent threshold shift, TTS = temporary threshold shift
[3]Distances for bin E3 are provided for the Offshore Area only since sea turtle analyses were based on occurrence in the Offshore Area only.

Table 3.5-6: SEL Based Ranges (in meters) to TTS and PTS for Sea Turtles Exposed to Explosives

Range to Effects for Explosives Bin: Sea turtles[1]				
Bin[2]	***Source Depth (meters)***	***Cluster Size***	***Range to PTS (meters)[1]***	***Range to TTS (meters)[1]***
E1	0.1	1	0 (0—0)	0 (0—0)
E2	0.1	1	0 (0—0)	1 (1—1)
E3[3]	18.25 Offshore Area	1	3 (3—3)	17 (16—17)
E4	10	2	7 (7—7)	51 (50—55)
	30	2	7 (7—7)	47 (45—55)
	70	2	7 (7—7)	37 (35—50)
	90	2	7 (7—7)	36 (35—45)
E5	0.1	1	1 (1—1)	7 (7—8)
		8	3 (3—4)	18 (17—21)
E7	10	1	40 (40—40)	232 (190—290)
	30	1	30 (30—30)	254 (190—420)
E8	45.75	1	40 (40—55)	283 (260—400)
E10	0.1	1	14 (13—21)	87 (60—440)
E11	91.4	1	155 (150—200)	1,108 (775—2,275)
	200	1	111 (110—120)	872 (800—925)

[1]Distances in meters (m). Average distance is shown with the minimum and maximum distances due to varying propagation environments in parentheses.
[2]Bin (net explosive weight, lb.): E1 (0.1–0.25), E2 (> 0.25–0.5), E3 (> 0.5–2.5), E4 (> 2.5–5), E5 (> 5–10), E7 (> 20–60), E8 (> 60–100), E10 (> 250–500), E11 (> 500–650)
Notes: PTS = permanent threshold shift, SEL = sound exposure level, TTS = temporary threshold shift
[3]Distances for bin E3 are provided for the Offshore Area only since sea turtle analyses were based on occurrence in the Offshore Area only.

3.5.2.2.2.3 Impacts from Explosives Under Alternative 1

Impacts from Explosives Under Alternative 1 During Training Activities

Leatherback turtles present in the Study Area may be exposed to sound or energy from explosions associated with training activities throughout the year. Leatherback turtles are highly migratory and lead a pelagic existence, and they tend to prefer foraging in productive offshore waters, such as waters off the coast of Washington and Oregon in the NWTT Offshore Area.

Activities using explosives would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activities Descriptions). General characteristics, quantities, and net explosive weights of in-water explosives used during training activities under Alternative 1 are provided in Section 3.0.3.2 (Explosive Stressors). Quantities and locations of fragment-producing explosives during training activities under Alternative 1 are shown in Section 3.0.3.4.4 (Military Expended Materials). The number of explosive sources in this Supplemental compared with the totals analyzed in the 2015 NWTT Final EIS/OEIS are described in Table 3.0-7.

Under Alternative 1, there could be fluctuation in the amount of explosions that could occur annually, although potential impacts would be similar from year to year. Training activities involving explosives would be concentrated in the NWTT Offshore Area. The Navy's mitigation requires detonations to occur greater than 50 NM from shore in the NWTT Offshore Area during training activities.

The quantitative analysis predicts no leatherback turtles are likely to be exposed to the levels of explosive sound and energy that could cause TTS, PTS, injury, or mortality during a maximum year of training under Alternative 1 (U.S. Department of the Navy, 2017b). As discussed in Section 5.3.3 (Explosive Stressors), procedural mitigation includes ceasing explosive detonations (e.g., ceasing deployment of an explosive bomb) if a sea turtle is observed in the mitigation zone whenever and wherever applicable activities occur. In addition to this procedural mitigation, the Navy will implement mitigation to avoid or reduce impacts from explosions on seafloor resources in mitigation areas throughout the Study Area, as described in Appendix K (Geographic Mitigation Assessment). This will further reduce the potential for impacts on sea turtles that shelter and feed on live hard bottom, artificial reefs, and shipwrecks.

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

Some sea turtles may behaviorally respond to the sound of an explosive. A sea turtle's behavioral response to a single detonation or explosive cluster is expected to be limited to a short-term (seconds to minutes) startle response, as the duration of noise from these events is very brief. Limited research and observations from air gun studies (see Section 3.5.2.2.2.1, Methods for Analyzing Impacts from Explosives) suggest that if sea turtles are exposed to repetitive impulsive sounds in close proximity, they may react by increasing swim speed, avoiding the source, or changing their position in the water column. There is no evidence to suggest that any behavioral response would persist beyond the sound exposure. Because the duration of most explosive events is brief, the potential for masking is low. The *ANSI Sound Exposure Guidelines* (Popper et al., 2014) consider masking to not be a concern for sea turtles exposed to explosions.

A physiological stress response is assumed to accompany any injury, hearing loss, or behavioral reaction. A stress response is a suite of physiological changes that are meant to help an organism mitigate the impact of a stressor. While the stress response is a normal function for an animal dealing with natural stressors in their environment, chronic stress responses could reduce an individual's fitness.

Designated leatherback turtle critical habitat, which includes the physical and biological features of leatherback turtle critical habitat (i.e., the occurrence of prey species, primarily jellyfish), overlaps with the NWTT Study Area as described in Section 3.5.1.4 (Leatherback Sea Turtle [*Dermochelys coriacea*]). Most, although not all, detonations would occur greater than 50 NM from shore in the Offshore Area of the NWTT Study Area. As discussed in the Section 3.8.2.2.1.1 (Impacts from Explosives under Alternative 1) of the Marine Invertebrates section, impacts to pelagic marine invertebrates (e.g., jellyfish) from explosions would be insignificant. Only jellyfish in very close proximity to a blast could be exposed for a brief duration; however, these exposures would not affect the overall prey availability for leatherback turtles. Impacts, if any, to prey species would be minimal, thus explosions would have no discernible impact on the condition, distribution, diversity, and abundance and density of prey species necessary to support individual as well as population growth, reproduction, and development of leatherback turtles in the Study Area.

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

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 1 may affect the ESA-listed leatherback turtle and leatherback turtle critical habitat. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA.

Impacts from Explosives Under Alternative 1 During Testing Activities

Leatherback turtles present in the Study Area may be exposed to sound or energy from explosions associated with testing activities throughout the year. Leatherback turtles are highly migratory and lead a pelagic existence, and they tend to prefer foraging in productive offshore waters, such as waters off the coast of Washington and Oregon in the NWTT Offshore Area.

Activities using explosives would be conducted as described in Chapter 2 (Description of Proposed Action and Alternatives) and Appendix A (Navy Activities Descriptions). General characteristics, quantities, and net explosive weights of in-water explosives used during testing activities under Alternative 1 are provided in Section 3.0.3.2 (Explosive Stressors). Quantities and locations of fragment-producing explosives during testing activities under Alternative 1 are shown in Section 3.0.3.4.4 (Military Expended Materials). The number of explosive sources in this Supplemental compared with the totals analyzed in the 2015 NWTT Final EIS/OEIS are described in Table 3.0-7.

Under Alternative 1, the amount of explosions during testing activities would be the same year to year. All testing involving explosives would occur in the Offshore Area, and with the exception of mine countermeasure and neutralization testing (new testing activities in Phase III), explosive testing activities would occur at distances greater than 50 NM from shore. This new activity would occur closer to shore than other activities analyzed in the 2015 NWTT Final EIS/OEIS that involved the use of in-water explosives. This activity would occur greater than 3 NM from shore in the Quinault Range Site, or greater than 12 NM from shore elsewhere in the Offshore Area but would not occur off the coast of California. This activity would occur in water depths shallower than 1,000 ft. (typically 300 ft.). Explosives would not be used in the Olympic Coast National Marine Sanctuary. Section 5.3.3 (Explosive Stressors) outlines the procedural mitigation measures for explosive stressors to reduce potential impacts on biological resources.

The general impacts from explosives during testing would be similar in severity to those described above in Section 3.5.2.2.2.3 (Impacts from Explosives Under Alternative 1 – Impacts from Explosives Under Alternative 1 During Training Activities), however explosives are used less frequently during testing activities than during training activities; therefore, there may be slightly fewer impacts, if any, during testing activities.

The quantitative analysis predicts that no leatherback turtles are likely to be exposed to the levels of explosive sound and energy that could cause TTS, PTS, injury, or mortality during a maximum year of testing activities under Alternative 1 (U.S. Department of the Navy, 2017b). As discussed in Section 5.3.3 (Explosive Stressors), procedural mitigation includes ceasing explosive detonations (e.g., delaying detonation of an explosive sonobuoy) if a sea turtle is observed in the mitigation zone whenever and wherever applicable activities occur. In addition to procedural mitigation, the Navy will implement mitigation to avoid or reduce impacts from explosions on seafloor resources in mitigation areas throughout the Study Area, as described in Appendix K (Geographic Mitigation Assessment). This will further reduce the potential for impacts on sea turtles that shelter and feed on live hard bottom, artificial reefs, and shipwrecks.

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

Some sea turtles may behaviorally respond to the sound of an explosive. A sea turtle's behavioral response to a single detonation or explosive cluster is expected to be limited to a short-term (seconds to minutes) startle response, as the duration of noise from these events is very brief. Limited research and observations from air gun studies (see Section 3.5.2.2.2.1, Methods for Analyzing Impacts from Explosives) suggest that if sea turtles are exposed to repetitive impulsive sounds in close proximity, they may react by increasing swim speed, avoiding the source, or changing their position in the water column. There is no evidence to suggest that any behavioral response would persist beyond the sound exposure. Because the duration of most explosive events is brief, the potential for masking is low. The *ANSI Sound Exposure Guidelines* (Popper et al., 2014) consider masking to not be a concern for sea turtles exposed to explosions.

A physiological stress response is assumed to accompany any injury, hearing loss, or behavioral reaction. A stress response is a suite of physiological changes that are meant to help an organism mitigate the impact of a stressor. While the stress response is a normal function for an animal dealing with natural stressors in their environment, chronic stress responses could reduce an individual's fitness.

Designated leatherback turtle critical habitat, which includes the physical and biological features of leatherback turtle critical habitat (i.e., the occurrence of prey species, primarily jellyfish), overlaps with the NWTT Study Area as described in Section 3.5.1.4 (Leatherback Sea Turtle [*Dermochelys coriacea*]). As described above, most, although not all, detonations would occur greater than 50 NM from shore in the NWTT Study Area. Procedural mitigation for jellyfish aggregations during torpedo explosive testing activities would help reduce impacts to leatherback turtle critical habitat in the area where critical habitat and torpedo explosive testing activities may overlap in waters greater than 50 NM from shore. As discussed in the Section 3.8.2.2.1.1 (Impacts from Explosives under Alternative 1) of the Marine Invertebrates section, impacts to pelagic marine invertebrates (e.g., jellyfish) from explosions would be insignificant. Only jellyfish in very close proximity to a blast could be exposed for a brief duration; however, these exposures would not affect the overall prey availability for leatherback turtles. Impacts, if any, to prey species would be minimal, thus explosions would have no discernible impact on the condition, distribution, diversity, and abundance and density of prey species necessary to support individual as well as population growth, reproduction, and development of leatherback turtles in the Study Area.

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

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 1 may affect the ESA-listed leatherback turtle and leatherback turtle critical habitat. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA.

3.5.2.2.2.4 Impacts from Explosives Under Alternative 2

Impacts from Explosives Under Alternative 2 During Training Activities

Leatherback turtles present in the Study Area may be exposed to sound or energy from explosions associated with training activities throughout the year. Leatherback turtles are highly migratory and lead a pelagic existence, and they tend to prefer foraging in productive offshore waters, such as waters off the coast of Washington and Oregon in the NWTT Offshore Area.

As described in Chapter 2 (Description of Proposed Action and Alternatives), Section 3.0.3.2 (Explosive Stressors), and Appendix A (Navy Activities Descriptions), training activities under Alternative 2 reflects the maximum number of testing activities that could occur within a given year. This would result in an increase of explosive use compared to Alternative 1. The locations, types, and severity of predicted impacts would similar to those described above in Section 3.5.2.2.2.3 (Impacts from Explosives Under Alternative 1 - Impacts from Explosives Under Alternative 1 During Training Activities), with additional anti-submarine warfare exercises occurring in offshore locations. The number of explosive sources in this Supplemental compared with the totals analyzed in the 2015 NWTT Final EIS/OEIS are described in Table 3.0-7.

The quantitative analysis predicts no leatherback turtles are likely to be exposed to the levels of explosive sound and energy that could cause TTS, PTS, injury, or mortality during a maximum year of training under Alternative 2.

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

Pursuant to the ESA, the use of explosives during training activities as described under Alternative 2 may affect the ESA-listed leatherback turtle and leatherback turtle critical habitat.

Impacts from Explosives Under Alternative 2 During Testing Activities

As described in Chapter 2 (Description of Proposed Action and Alternatives), Section 3.0.3.2 (Explosive Stressors), and Appendix A (Navy Activities Descriptions), testing activities involving the use of explosives is identical under Alternative 1 and Alternative 2; therefore, the locations, types, and severity of predicted impacts would be the same as those described above in Section 3.5.2.2.2.3 (Impacts from Explosives Under Alternative 1 – Impacts from Explosives Under Alternative 1 During Testing Activities). The number of explosive sources in this Supplemental compared with the totals analyzed in the 2015 NWTT Final EIS/OEIS are described in Table 3.0-7.

The quantitative analysis predicts that no leatherback turtles are likely to be exposed to the levels of explosive sound and energy that could cause TTS, PTS, injury, or mortality during a maximum year of training activities under Alternative 2.

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

Pursuant to the ESA, the use of explosives during testing activities as described under Alternative 2 may affect the ESA-listed leatherback turtle and leatherback turtle critical habitat.

3.5.2.2.2.5 Impacts from Explosives Under the No Action Alternative

Under the No Action Alternative, the Navy would not conduct proposed at-sea training and testing activities in the Study Area. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

Discontinuing the training and testing activities would result in fewer explosive stressors within the marine environment where activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would remove the potential for explosive impacts on sea turtles, but would not measurably improve the overall distribution or abundance of sea turtles.

3.5.2.3 Energy Stressors

The energy stressors that may impact sea turtles include in-water electromagnetic devices and lasers. As shown in Table 3.0-9, activities that use in-water devices would only occur within Inland Waters (where sea turtles are not expected to occur); therefore, impacts from in-water devices are not analyzed for sea turtles. Lasers are the only energy stressor that may potentially impact sea turtles. As discussed in Section 3.0.3.3.2.1 (Low-Energy Lasers), analysis has shown that low-energy lasers would not affect animals and therefore do not require further analysis.

High-energy lasers were not covered in the 2015 NWTT Final EIS/OEIS and represent a new activity analyzed in this Supplemental. As discussed in Section 3.0.3.3.2.2 (High-Energy Lasers), high-energy lasers can be divided into high-energy laser weapons and laser-based optical communication systems. Both of these systems would be tested in in the Offshore Area; however, testing of laser-based optical communication systems was discussed in Section 3.0.3.3.2.2 (High-Energy Lasers) and dismissed from further evaluation. The primary concern for high-energy laser weapons systems is the potential for a sea turtle to be struck with the laser beam at or near the water's surface, where extended exposure could result in injury or death. The potential for exposure to a high-energy laser beam decreases as the water depth increases. Because high-energy laser weapons platforms are typically helicopters and ships, sea turtles would likely transit away or submerge in response to other stressors, such as ship or aircraft noise, although some sea turtles may not exhibit a response to an oncoming vessel or aircraft, increasing the risk of contact with the laser beam. The Navy conducted statistical modeling to estimate the probability of a leatherback sea turtle being struck by a high-energy laser during testing activities (high-energy laser weapons are not proposed for training activities) (see Appendix F, Military Expended Material and Direct Strike Impact Analyses). As a basis for modeling the probability of high-energy laser strike, the Navy used estimates for loggerhead sea turtles (U.S. Department of the Navy, 2018). The modeling resulted in no estimated exposures to a high-energy laser strike (see Appendix F, Military Expended Material and Direct Strike Impact Analyses, Table F-4). Based on the modeling results and other factors that would decrease likelihood of exposure, there is a reasonable assumption that no strike of sea turtles would occur.

3.5.2.3.1 Impacts from In-Water Electromagnetic Devices

As shown in Table 3.0-9, activities that use in-water devices would only occur within Inland Waters (where sea turtles are not expected to occur); therefore, impacts from in-water devices are not analyzed for sea turtles.

3.5.2.3.2 Impacts from High-Energy Lasers

This section provides the modeling results to estimate potential exposures to sea turtles from testing activities that use high-energy laser weapons on sea turtles in the Offshore Area.

3.5.2.3.2.1 Impacts from High-Energy Lasers Under Alternative 1

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

High-energy laser weapons would not be used during training activities under Alternative 1, so there would be no impacts.

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

As discussed in Section 3.0.3.3.2.2 (High-Energy Lasers) and shown in Table 3.0-10, under Alternative 1 there would be up to 55 testing activities per year involving the use of high-energy laser weapons. One of those 55 activities is a test of a laser-based optical communication system, which was discussed in Section 3.0.3.3.2.2 and dismissed from further evaluation. The remaining 54 annual testing activities would involve the use of high-energy laser weapons in the Offshore portion of the Study Area. As stated previously, high-energy laser weapons proposed under Alternative 1 testing activities would have no impact on leatherback sea turtles. This conclusion is based on modeling results in Appendix F (Military Expended Material and Direct Strike Impact Analyses, see Table F-4), which estimate no exposures to sea turtles over the course of each year of testing activities, as well as the location of where laser-based optical communication system testing would occur (Inland Waters where no sea turtles are anticipated to occur).

The single PCE identified for designated critical habitat for the Pacific leatherback sea turtle (the occurrence of prey species, primarily scyphomedusae of the order Semaeostomeae of sufficient condition, distribution, diversity, abundance, and density necessary to support individual as well as population growth, reproduction, and development) would not be impacted. Therefore, there would be no impacts on designated critical habitat for the leatherback sea turtle.

Pursuant to the ESA, the use of high-energy laser weapons during testing activities as described under Alternative 1 would have no effect on leatherback sea turtles and would have no effect on designated critical habitat for the leatherback sea turtle.

3.5.2.3.2.2 Impacts from High-Energy Lasers under Alternative 2

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

No high-energy laser weapons are proposed for training activities under Alternative 2.

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

As shown in Table 3.0-10, a total 54 testing activities involving the use of high-energy laser weapons are proposed to be conducted in the Offshore Area under Alternative 2, the same as under Alternative 1. As stated previously, high-energy laser weapons proposed under Alternative 1 testing activities would have no impact on leatherback sea turtles. This conclusion is based on modeling results in Appendix F (Military Expended Material and Direct Strike Impact Analyses, see Table F-4), which estimate no exposures to sea turtles over the course of each year of testing activities, Inland Waters where no sea turtles are anticipated to occur).

Because of the unlikely exposure of sea turtle prey items to high-energy laser weapons, the single PCE identified for designated critical habitat for the Pacific leatherback sea turtle (the occurrence of prey species, primarily scyphomedusae of the order Semaeostomeae of sufficient condition, distribution, diversity, abundance, and density necessary to support individual as well as population growth, reproduction, and development) would not be impacted.

Pursuant to the ESA, the use of high-energy laser weapons during testing activities as described under Alternative 2 would have no effect on leatherback sea turtles and would have no effect on designated critical habitat for the leatherback sea turtle.

3.5.2.3.2.3 Impacts from High-Energy Lasers Under the No Action Alternative

Under the No Action Alternative, proposed training and testing activities would not occur. Energy stressors, as listed above, would not be introduced into the marine environment. Therefore, existing environmental conditions would remain unchanged after cessation of ongoing training and testing activities.

Discontinuing the training and testing activities would result in fewer energy stressors within the marine environment where training and testing activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would lessen the potential for impacts from energy stressors on individual leatherback sea turtles, but would not measurably improve the status of leatherback sea turtle populations or subpopulations. Similarly, there would not be any measurable change in the PCEs under the No Action Alternative for leatherback critical habitat.

3.5.2.4 Physical Disturbance and Strike Stressors

The physical disturbance and strike stressors that may impact sea turtles include (1) vessels and in-water devices, (2) military expended materials, and (3) seafloor devices. The annual number of activities including vessels and in-water devices, the annual number of military expended materials, and the annual number of activities including seafloor devices are shown in Tables 3.0-12 through 3.0-18. Section 5.3.4 (Physical Disturbance and Strike Stressors) in Chapter 5 (Mitigation) and Section 2.3.3 (Standard Operating Procedures) describe the measures included as part of the proposed action that are part of mitigation measures and standard operating procedures to reduce or avoid potential impacts on sea turtles from physical disturbance and strike stressors.

3.5.2.4.1 Impacts from Vessels and In-Water Devices

Since the release of the 2015 NWTT Final EIS/OEIS, updated information is available regarding vessel traffic in and around major port facilities within the NWTT Study Area. Data from the ports of Vancouver, Seattle, and Tacoma indicated there were in excess of 7,000 commercial vessel transits in 2017 associated with visits to just those ports (The Northwest Seaport Alliance, 2018; Vancouver Fraser Port Authority, 2017). This number of vessel transits does not account for other vessel traffic in the Strait of Juan de Fuca or Puget Sound resulting from commercial ferries, tourist vessels, or recreational vessels. Additional commercial traffic in the NWTT Study Area also includes vessels transiting offshore along the Pacific coast, bypassing ports in Canada and Washington, traffic associated with ports to the south along the coast of Washington and in Oregon, and in addition to vessel traffic in Southeast Alaska. This level of commercial vessel traffic for the ports of Vancouver, Seattle, and Tacoma is approximately the same as was presented in the 2015 NWTT Final EIS/OEIS.

In the NWTT Study Area, the existing marine environment is dominated by non-Navy vessel traffic given the Navy has in total, the following homeported operational vessels: 2 aircraft carriers, 7 destroyers, 14 submarines, and 22 smaller security vessels. Appendix A (Navy Activities Descriptions) describes the number of vessels used during the various types of Navy's proposed activities. Activities involving Navy vessel movement would be widely dispersed throughout the Study Area.

3.5.2.4.1.1 Impacts from Vessels and In-Water Devices Under Alternative 1

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

Under Alternative 1, the combined number of proposed training activities in the Offshore Area involving the movement of vessels and the use of in-water devices would increase (Table 3.0-12 and Table 3.0-13) compared to those proposed in the 2015 NWTT Final EIS/OEIS. Vessel movement would decrease slightly in the Offshore Area (from 1,156 to 1,144 annual activities). The activities would occur in the same locations and in a similar manner as were analyzed previously. There is an overall increase in the use of in-water devices (Table 3.0-13), all of which are associated with small, slow-moving unmanned underwater vehicles. Because the increases are to activities in which the in-water devices are small and slow moving, the impacts on leatherback sea turtles would be similar. The proposed increase of approximately 100 in-water devices would not change that conclusion.

Exposure to vessels and in-water devices used in training and testing activities may cause short-term disturbance to an individual turtle because if a turtle were struck, it could lead to injury or death. As demonstrated by scars on all species of sea turtles, they are not always able to avoid being struck; therefore, vessel strikes are a potential cause of mortality for these species. Although the likelihood of being struck is minimal, sea turtles that overlap with Navy exercises are more likely to encounter vessels. Exposure to vessels may change an individual's behavior, growth, survival, annual reproductive success, or lifetime reproductive success (fitness). Exposure to vessels is not expected to result in population-level impacts.

Vessel movements and in-water device use would occur under Alternative 1 within designated critical habitat for the leatherback sea turtle. The single PCE essential for the conservation of leatherbacks in the marine waters of the U.S. west coast is the occurrence of prey species in sufficient numbers and quality to sustain leatherback foraging activities. While some of the leatherback sea turtle's preferred prey may be impacted by vessels during training activities, effects are expected to be minor and temporary with no overall impacts on prey availability, and would have no impact to the overall prey density in designated leatherback sea turtle critical habitat. Therefore, there would be no measurable impacts on critical habitat resulting from vessel or in-water device use in the Study Area.

The analysis in Section 3.5.3.3 (Physical Disturbance and Strike Stressors) in the 2015 NWTT Final EIS/OEIS concluded that the physical disturbance or strike from a military vessel, in-water device, military expended material, or seafloor device is unlikely. There are no records of any military vessel strikes to sea turtles in the Study Area during training or testing activities. In areas outside the Study Area (e.g., Hawaii and Southern California), there have been recorded military vessel strikes of sea turtles. However, these are areas where the number of military vessels is much higher and training and testing activities occur more often than in the Study Area.

As stated in the 2015 NWTT Final EIS/OEIS, the impact of vessels and in-water devices on leatherback sea turtles would remain inconsequential due to (1) the wide dispersal of large vessels in open ocean areas and the widespread locations of where activities that use in-water devices would occur, (2) the low realistic potential of certain in-water devices to strike living marine resources because they either move slowly through the water column (e.g., most UUVs) or are closely monitored by observers manning the towing platform, and (3) the scattered distribution of turtles at sea.

Because of the unlikely exposure of sea turtle prey items to vessel transits and in-water device use, the single PCE identified for designated critical habitat for the Pacific leatherback sea turtle (the occurrence of prey species, primarily scyphomedusae of the order Semaeostomeae of sufficient condition, distribution, diversity, abundance, and density necessary to support individual as well as population growth, reproduction, and development) would not be impacted.

In 2015, NMFS provided the Navy with a biological opinion on proposed training and testing activities included in the 2015 NWTT Final EIS/OEIS. The NMFS's biological opinion concluded that no takes would likely occur from physical disturbance and strike stressors. The activities described under Alternative 1 in this Supplemental would not be sufficient to modify the physical disturbance and strike conclusions provided in NMFS's 2015 Biological Opinion.

Pursuant to the ESA, the use of vessels and in-water devices during training activities under Alternative 1 may affect the ESA-listed leatherback sea turtle. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA on physical disturbance and strike stressors. These activities would have no effect on designated critical habitat.

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

Under Alternative 1, the combined number of proposed testing activities in the Offshore Area involving the movement of vessels and the use of in-water devices (Table 3.0-12 and Table 3.0-13) would increase compared to those proposed in the 2015 NWTT Final EIS/OEIS. Vessel movement would increase in the Offshore Area (from 181 to 283 annual activities).

There is also an overall increase in the use of in-water devices during testing activities (Table 3.0-13), all of which are associated with small, slow-moving unmanned underwater vehicles. The proposed increase of in-water devices would not change the conclusion presented in the 2015 NWTT Final EIS/OEIS. The activities would occur in the same locations and in a similar manner as were analyzed previously.

In spite of these increases in the Offshore portion of the Study Area, and as described in the 2015 NWTT Final EIS/OEIS, these vessel and in-water device activities remain unlikely to result in a strike to any leatherback sea turtles. The proposed increase of vessel and in-water device activities would not change that conclusion. As stated in the 2015 NWTT Final EIS/OEIS, the impact of vessels and in-water devices on leatherback sea turtles would be inconsequential due to (1) the wide dispersal of large vessels in open ocean areas and the widespread locations of where activities that use in-water devices would occur, (2) the low realistic potential of certain in-water devices to strike living marine resources because they either move slowly through the water column (e.g., most UUVs) or are closely monitored by observers manning the towing platform, and (3) the scattered distribution of turtles at sea.

Because of the unlikely exposure of sea turtle prey items to vessel transits and in-water device use, the single PCE identified for designated critical habitat for the Pacific leatherback sea turtle (the occurrence of prey species, primarily scyphomedusae of the order Semaeostomeae of sufficient condition, distribution, diversity, abundance, and density necessary to support individual as well as population growth, reproduction, and development) would not be impacted.

Pursuant to the ESA, the use of vessels and in-water devices during testing activities under Alternative 1 may affect the ESA-listed leatherback sea turtle. The Navy has consulted with NMFS, as required by section 7(a)(2) of the ESA, on the use of vessels and in-water devices. These activities would have no effect on leatherback critical habitat.

3.5.2.4.1.2 Impacts from Vessels and In-Water Devices Under Alternative 2

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

Under Alternative 2, the combined number of proposed training activities involving the movement of vessels and the use of in-water devices would be slightly greater than Alternative 1 (Table 3.0-12 and Table 3.0-13) and greater than those proposed in the 2015 NWTT Final EIS/OEIS. Vessel movement would increase in the Offshore Area compared to Alternative 1 (1,144 for Alternative 1 compared to 1,249 for Alternative 2), and increases (1,156 to 1,249) compared to levels presented in the 2015 NWTT Final EIS/OEIS (Table 3.0-12). There would also be a slight total increase in the use of in-water devices compared to Alternative 1 (541 for Alternative 1 compared to 547) and an increase from levels presented in the 2015 NWTT Final EIS/OEIS (495 to 547) (Table 3.0-13).

All of the increased in-water device activities are associated with small, slow-moving unmanned underwater vehicles. Because the increases are to activities in which the in-water devices are unlikely to have an impact to leatherback sea turtles (small, slow-moving in-water devices), the impacts to leatherback sea turtles would be similar. The proposed increase to in-water devices would not change that conclusion. The activities would occur in the same locations and in a similar manner as were analyzed previously. As stated in the 2015 NWTT Final EIS/OEIS, the impact of vessels and in-water devices on leatherback sea turtles would remain inconsequential due to(1) the wide dispersal of large vessels in open ocean areas and the widespread locations of where activities that use in-water devices would occur, (2) the low realistic potential of certain in-water devices to strike living marine resources because they either move slowly through the water column (e.g., most UUVs) or are closely monitored by observers manning the towing platform, and (3) the scattered distribution of turtles at sea. As stated above under Alternative 1, NMFS's biological opinion on proposed training and testing activities included in the 2015 NWTT Final EIS/OEIS concluded that no takes of leatherback sea turtle would likely occur from physical disturbance and strike stressors, and no adverse effects on designated critical habitat would occur. The activities described under Alternative 2 in this Supplemental would not be sufficient to modify the physical disturbance and strike conclusions provided in NMFS's 2014 Biological Opinion.

Pursuant to the ESA, the use of vessels and in-water devices during training activities under Alternative 2 may affect the ESA-listed leatherback sea turtle and would have no effect on designated critical habitat.

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

Under Alternative 2, the number of proposed testing activities in the Offshore Area involving the combined movement of vessels and the use of in-water devices would increase compared to Alternative 1 and those proposed in the 2015 NWTT Final EIS/OEIS (Table 3.0-12 and Table 3.0-13). Vessel movement would increase in the Offshore Area compared to Alternative 1 (from 181 to 295) and would increase compared to numbers presented in the 2015 NWTT Final EIS/OEIS (from 181 to 295 annual activities).

There would also be an increase in the use of in-water devices compared to Alternative 1 (215 for Alternative 1 compared to 224) and an increase from levels presented in the 2015 NWTT Final EIS/OEIS (156 to 224) (Table 3.0-13).

The activities would occur in the same locations and in a similar manner as were analyzed previously. In spite of these increases, and as described in the 2015 NWTT Final EIS/OEIS, these vessel and in-water device activities remain unlikely to result in a strike to any leatherback sea turtles. The proposed increase of vessel and in-water device activities would not change that conclusion. As stated in the 2015 NWTT Final EIS/OEIS, the impact of vessels and in-water devices on leatherback sea turtles would remain inconsequential due to (1) the wide dispersal of large vessels in open ocean areas and the widespread locations of where activities that use in-water devices would occur, (2) the low realistic potential of certain in-water devices to strike living marine resources because they either move slowly through the water column (e.g., most UUVs) or are closely monitored by observers manning the towing platform, and (3) scattered distribution of turtles at sea.

Pursuant to the ESA, the use of vessels and in-water devices during testing activities under Alternative 2 may affect the ESA-listed leatherback sea turtle and would have no effect on designated critical habitat.

3.5.2.4.1.3 Impacts from Vessels and In-Water Devices Under the No Action Alternative

Under the No Action Alternative, proposed training and testing activities would not occur. Physical disturbance and strike stressors as listed above would not be introduced into the marine environment. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

Discontinuing the training and testing activities would result in fewer physical disturbance and strike stressors within the marine environment where Navy training and testing activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would lessen potential impacts from vessels and in-water devices on individual leatherback sea turtles but would not measurably improve the status of leatherback sea turtle populations. Similarly, there would not be any measurable change in the PCEs under the No Action Alternative for leatherback critical habitat.

3.5.2.4.2 Impacts from Military Expended Materials

For the analysis of impacts from military expended material as physical disturbance stressors, see Section 3.5.3.3.3 (Impacts from Military Expended Materials) in the 2015 NWTT Final EIS/OEIS, and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015; National Oceanic and Atmospheric Administration, 2015a). Since the 2015 NWTT Final EIS/OEIS, there has been no new or emergent science that would change in any way the rationale for the dismissal of impacts from military expended material as presented in the 2015 analyses. There have been no known instances of physical disturbance or strike to any sea turtles as a result of training and testing activities involving the use of military expended materials prior to or since the 2015 NWTT Final EIS/OEIS.

3.5.2.4.2.1 Impacts from Military Expended Materials Under Alternative 1

Impacts from Military Expended Materials Under Alternative 1 for Training Activities

Under Alternative 1 and as presented in Section 3.0 (Introduction), the use of military expended materials during training activities would decrease in comparison to the 2015 NWTT Final EIS/OEIS (Tables 3.0-14 through 3.0-17). When the amount of military expended materials (Tables 3.0-14 through 3.0-17) is combined, the number of items proposed to be expended in the Offshore Area under Alternative 1 decreases compared to ongoing activities. The activities that expend military materials would occur in the same locations and in a similar manner as were analyzed previously. While the number military expended materials used during training activities would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015; National Oceanic and Atmospheric Administration, 2015a) remains valid; physical disturbance and strike impacts on sea turtles resulting from military expended materials are not anticipated.

Pursuant to the ESA, the use of military expended materials during training activities under Alternative 1 may affect the ESA-listed leatherback sea turtle. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA on the use of military expended materials. These activities would have no effect on designated critical habitat.

Impacts from Military Expended Materials Under Alternative 1 for Testing Activities

Under Alternative 1 and as presented in Section 3.0 (Introduction), the use of military expended materials during testing activities in the Offshore Area would increase in comparison to the 2015 NWTT Final EIS/OEIS (Tables 3.0-14 through 3.0-17). While the number of military expended materials used during testing activities would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015; National Oceanic and Atmospheric Administration, 2015a) remains valid; physical disturbance and strike impacts sea turtles resulting from military expended materials are not expected.

Pursuant to the ESA, the use of military expended materials during testing activities under Alternative 1 may affect the ESA-listed leatherback sea turtle. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA on the use of military expended materials. These activities would have no effect on designated critical habitat.

3.5.2.4.2.2 Impacts from Military Expended Materials Under Alternative 2

Impacts from Military Expended Materials Under Alternative 2 for Training Activities

Under Alternative 2, the number of military materials that would be expended during training activities is generally consistent with the number proposed for use in the 2015 NWTT Final EIS/OEIS. When the amount of military expended materials from Tables 3.0-14 through 3.0-17 are combined, the number of items proposed to be expended under Alternative 2 increase compared to both Alternative 1 and ongoing activities. While the number of military expended materials used during training activities in the Offshore Area would change under this Supplemental, the analysis presented in the 2015 NWTT Final

EIS/OEIS and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015; National Oceanic and Atmospheric Administration, 2015a) remains valid; physical disturbance and strike impacts sea turtles resulting from military expended materials are not expected.

Pursuant to the ESA, the use of military expended materials during training activities under Alternative 2 may affect the ESA-listed leatherback sea turtle and would have no effect on designated critical habitat.

Impacts from Military Expended Materials Under Alternative 2 for Testing Activities

Under Alternative 2, when the amount of military expended materials from Tables 3.0-14 through 3.0-17 are combined, the number of items proposed to be expended would increase compared to Alternative 1 and ongoing activities. While the number of military expended materials used during testing activities in the Offshore Area would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015c; National Oceanic and Atmospheric Administration, 2015a) remains valid; physical disturbance and strike impacts on sea turtles resulting from military expended materials are not expected.

Pursuant to the ESA, the use of military expended materials during testing activities under Alternative 2 may affect the ESA-listed leatherback sea turtle and would have no effect on designated critical habitat.

3.5.2.4.2.3 Impacts from Military Expended Materials Under the No Action Alternative

Under the No Action Alternative, proposed training and testing activities would not occur. Physical disturbance and strike stressors as listed above would not be introduced into the marine environment. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

Discontinuing the training and testing activities would result in fewer physical disturbance and strike stressors within the marine environment where Navy training and testing activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would remove the potential for impacts from military expended material on individual leatherback sea turtles, but would not measurably improve the status of leatherback sea turtle populations.

3.5.2.4.3 Impacts from Seafloor Devices

For the analysis of impacts from military expended material as physical disturbance stressors, see Section 3.5.3.3.4 (Impacts from Seafloor Devices) in the 2015 NWTT Final EIS/OEIS, and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015; National Oceanic and Atmospheric Administration, 2015a). The only seafloor devices proposed for use in the Offshore Area are mine shapes and anchors. Since the 2015 NWTT Final EIS/OEIS, there has been no new or emergent science that would change in any way the rationale for the dismissal of impacts from seafloor devices as presented in the 2015 analyses. There have been no known instances of physical disturbance or strike to any sea turtles as a result of training and testing activities involving the use of seafloor devices prior to or since the 2015 NWTT Final EIS/OEIS.

3.5.2.4.3.1 Impacts from Seafloor Devices Under Alternative 1

Impacts from Seafloor Devices Under Alternative 1 for Training Activities

There are no Offshore Area training activities under any Alternative in which seafloor devices would be used. Therefore, there are no impacts on sea turtles that may be present in the Study Area from training activities.

Impacts from Seafloor Devices Under Alternative 1 for Testing Activities

Under Alternative 1 and as presented in Section 3.0 (Introduction), testing activities in the Offshore Area using seafloor devices would decrease in comparison to the 2015 NWTT Final EIS/OEIS (Tables 3.0-18). While the number of testing activities using seafloor devices would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015; National Oceanic and Atmospheric Administration, 2015a) remains valid; physical disturbance and strike impacts on sea turtles resulting from seafloor devices are not expected.

Pursuant to the ESA, the use of seafloor devices during testing activities under Alternative 1 may affect the ESA-listed leatherback sea turtle. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA on seafloor devices. These activities would have no effect on designated critical habitat.

3.5.2.4.3.2 Impacts from Seafloor Devices Under Alternative 2

Impacts from Seafloor Devices Under Alternative 2 for Training Activities

There are no Offshore Area training activities under any Alternative in which seafloor devices would be used. Therefore, there are no impacts on sea turtles that may be present in the Study Area from training activities.

Impacts from Seafloor Devices Under Alternative 2 for Testing Activities

Under Alternative 2, the total number of testing activities that include the use of seafloor devices in the Offshore Area would decrease compared to what was analyzed in the 2015 NWTT Final EIS/OEIS and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015; National Oceanic and Atmospheric Administration, 2015a), and increase slightly as compared to Alternative 1. While the number of testing activities using seafloor devices would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS, and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015; National Oceanic and Atmospheric Administration, 2015a) remains valid; physical disturbance and strike impacts to sea turtles resulting from seafloor devices are not expected.

Pursuant to the ESA, the use of seafloor devices during testing activities under Alternative 2 may affect the ESA-listed leatherback sea turtle and would have no effect on designated critical habitat.

3.5.2.4.3.3 Impacts from Seafloor Devices Under the No Action Alternative

Under the No Action Alternative, proposed training and testing activities would not occur. Physical disturbance and strike stressors as listed above would not be introduced into the marine environment. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

Discontinuing the training and testing activities would result in fewer physical disturbance and strike stressors within the marine environment where Navy training and testing activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would remove the potential for impacts from seafloor devices on individual leatherback sea turtles but would not measurably improve the status of leatherback sea turtle populations.

3.5.2.5 Entanglement Stressors

The entanglement stressors that may impact leatherback sea turtles include (1) wires and cables and (2) decelerators/parachutes. Since the publication of the 2015 NWTT Final EIS/OEIS, the Navy has developed systems for testing disruption and stopping of target ship propulsion systems.

Biodegradable polymer is a new stressor not previously analyzed in other resources sections of this Supplemental, but would only be used in the Inland Waters portion of the Study Area. Because leatherback sea turtles do not occur in inland waters, leatherback sea turtles would not be at risk of entanglement by biodegradable polymers and are therefore not discussed further as a potential stressor for sea turtles.

For the analysis of wires and cables and decelerators/parachutes as entanglement stressors, see Section 3.5.3.4 (Entanglement Stressors) in the 2015 NWTT Final EIS/OEIS and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015; National Oceanic and Atmospheric Administration, 2015a).

3.5.2.5.1 Impacts from Wires and Cables

Wires and cables include fiber optic cables, guidance wires, and sonobuoy wires, as detailed in Table 3.0-19 in this Supplemental and the 2015 NWTT Final EIS/OEIS. Since the 2015 NWTT Final EIS/OEIS, there has been no new or emergent science that would change in any way the rationale for the dismissal of wires and cables as presented in the 2015 analyses. There have been no known instances of entanglement of any marine mammals as a result of training and testing activities involving the use of wires and cables associated with Navy training and testing activities prior to or since the 2015 NWTT Final EIS/OEIS. Wires and cables are generally not expected to cause disturbance to sea turtles because of: (1) the number of wires and cables expended being relatively low in the Offshore Area (as shown in Table 3.0-19), decreasing the likelihood of encounter; (2) the physical characteristics of wires and cables; and (3) the behavior of the species, as sea turtles are unlikely to become entangled in an object that is resting on the seafloor. Exposure to wires and cables is not expected to result in population-level impacts for leatherback sea turtles. Activities involving fiber optic cables and guidance wires are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of prey species at the population level.

3.5.2.5.1.1 Impacts from Wires and Cables Under Alternative 1

<u>**Impacts from Wires and Cables Under Alternative 1 for Training Activities**</u>

Under Alternative 1 and as presented in Section 3.0 (Introduction), the use of wires and cables during training activities in the Offshore Area would increase in comparison to the 2015 NWTT Final EIS/OEIS (Table 3.0-19). While the number of wires and cables used during training activities would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015; National Oceanic and Atmospheric Administration, 2015a) remains valid; entanglement impacts to sea turtles resulting from wires and cables are not expected.

Pursuant to the ESA, the use of wires and cables during training activities under Alternative 1 may affect the ESA-listed leatherback sea turtle. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA on the use of wires and cables. These activities would have no effect on designated critical habitat.

<u>**Impacts from Wires and Cables Under Alternative 1 for Testing Activities**</u>

Testing activities under Alternative 1 that expend wires and cables would generally occur in a similar manner in the same locations, and in numbers that are not a significant change from the analyses presented in 2015. As a result, the impacts on sea turtles would be expected to be the same given the previous conclusions were not tied to the number of activities occurring. Exposure to wires and cables used in testing activities may cause short-term or long-term disturbance to an individual turtle because if a sea turtle were to become entangled in a wire or cable, it could free itself or it could lead to injury or death. Exposure to wires or cables may change an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment. However, wires and cables are generally not expected to cause disturbance to sea turtles because of: (1) the number of wires and cables expended being relatively low in the Offshore Area (as shown in Table 3.0-19), decreasing the likelihood of encounter; (2) the physical characteristics of wires and cables; and (3) the behavior of the species, as sea turtles are unlikely to become entangled in an object that is resting on the seafloor. Exposure to wires and cables is not expected to result in population-level impacts for leatherback sea turtles. Activities involving fiber optic cables and guidance wires are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of prey species at the population level.

Pursuant to the ESA, the use of wires and cables during testing activities under Alternative 1 may affect the ESA-listed leatherback sea turtle. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA on the use of wires and cables. These activities would have no effect on designated critical habitat.

3.5.2.5.1.2 Impacts from Wires and Cables Under Alternative 2

<u>**Impacts from Wires and Cables Under Alternative 2 for Training Activities**</u>

Under Alternative 2, the number of wires and cables that would be expended during training activities in the Offshore Area would increase compared to what was analyzed in the 2015 NWTT Final EIS/OEIS (Table 3.0-19). As with the 2015 NWTT Final EIS/OEIS and under Alternative 1, no fiber optic cables are proposed under Alternative 2 training activities. Two guidance wires are proposed to be expended in the Offshore Area under Alternative 2, none were proposed in the previous analysis. As shown in Table 3.0-19, the expenditure of sonobuoy wires in the Offshore Area is proposed to increase slightly (by 40 sonobuoy wires). Because the number and locations of these wires and cables is similar to those analyzed in the 2015 NWTT Final EIS/OEIS, the impacts to leatherback sea turtles would be expected to be the same as analyzed under Alternative 1.

Pursuant to the ESA, the use of wires and cables during training activities under Alternative 2 may affect the ESA-listed leatherback sea turtle and would have no effect on designated critical habitat.

<u>**Impacts from Wires and Cables Under Alternative 2 for Testing Activities**</u>

Under Alternative 2, the number of expended wires and cables expended in the Offshore Area would increase compared to what was analyzed in the 2015 NWTT Final EIS/OEIS (16 additional fiber optic cables, 60 additional guidance wires, and 5,207 additional sonobuoy wires). Compared to Alternative 1, Alternative 2 testing activities would expend an additional 40 guidance wires and an additional 2,206 sonobuoy wires. Testing activities under Alternative 2 that expend wires and cables would generally occur in a similar manner in the same locations, and in numbers that are not a significant change from the analyses presented in 2015. As a result, the impacts on sea turtles would be expected to be the same given the previous conclusions were not tied to the number of expended wires and cables. Exposure to wires and cables used in testing activities may cause short-term or long-term disturbance to an individual turtle because if a sea turtle were to become entangled in a wire or cable, it could free itself or it could lead to injury or death. Exposure to wires or cables may change an individual's behavior, growth, survival, annual reproductive success, lifetime reproductive success (fitness), or species recruitment. However, wires and cables are generally not expected to cause disturbance to sea turtles because of: (1) the number of wires and cables expended being relatively low in the Offshore Area (as shown in Table 3.0-19), decreasing the likelihood of encounter; (2) the physical characteristics of wires and cables; and (3) the behavior of the species, as sea turtles are unlikely to become entangled in an object that is resting on the seafloor. Exposure to wires and cables is not expected to result in population-level impacts for leatherback sea turtles. Activities involving fiber optic cables and guidance wires are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of prey species at the population level.

Pursuant to the ESA, the use of wires and cables during testing activities under Alternative 2 may affect the ESA-listed leatherback sea turtle and would have no effect on designated critical habitat.

3.5.2.5.1.3 Impacts from Wires and Cables Under the No Action Alternative

Under the No Action Alternative, proposed training and testing activities would not occur. Entanglement stressors as listed above would not be introduced into the marine environment. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

Discontinuing the training and testing activities would result in fewer entanglement stressors within the marine environment where Navy training and testing activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would remove the potential for impacts from wires and cables on individual leatherback sea turtles, but would not measurably improve the status of leatherback sea turtle populations. Similarly, there would not be any measurable change in the PCEs under the No Action Alternative for leatherback critical habitat.

3.5.2.5.2 Impacts from Decelerators/Parachutes

Decelerators/parachutes include small, medium, large, and extra-large decelerator parachutes (Table 3.0-20).

3.5.2.5.2.1 Impacts from Decelerators/Parachutes Under Alternative 1

Impacts from Decelerators/Parachutes Under Alternative 1 for Training Activities

Under Alternative 1, the number of decelerators/parachutes that would be expended during training activities in the Offshore Area is generally consistent with the number proposed for use in the 2015 NWTT Final EIS/OEIS. As shown in Table 3.0-20, the expenditure of all size decelerators/parachutes in the Offshore Area is proposed to increase slightly. The activities that expend decelerators/parachutes would generally occur in the same locations and in a similar manner as were analyzed previously. Because the number and locations of these decelerators/parachutes is similar to those analyzed in the 2015 NWTT Final EIS/OEIS, the impacts to leatherback sea turtles would be expected to be the same. As stated in the 2015 NWTT Final EIS/OEIS, the impact of decelerators/parachutes on leatherback sea turtles would be inconsequential because of (1) the low densities of leatherback sea turtles present in the Offshore Area, (2) the unlikely event of a sea turtle being at the exact point where the decelerator/parachute lands, and (3) the negative buoyancy of decelerator/parachute constituents (reducing the probability of contact with sea turtles near the surface). Exposure to decelerators and parachutes is not expected to result in population-level impacts for leatherback sea turtles. Activities involving decelerators and parachutes are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of prey species at the population level.

Pursuant to the ESA, the use of decelerators/parachutes during training activities under Alternative 1 may affect the ESA-listed leatherback sea turtle. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA on the use of decelerators/parachutes. These activities would have no effect on designated critical habitat.

Impacts from Decelerators/Parachutes Under Alternative 1 for Testing Activities

Under Alternative 1, the number of decelerators/parachutes that would be expended during testing activities in the Offshore Area is increased compared to the number proposed for use in the 2015 NWTT Final EIS/OEIS. As shown in Table 3.0-20, the expenditure of small decelerators/parachutes is proposed to increase from 1,068 to 1,711. The activities that expend decelerators/parachutes would generally occur in the same locations and in a similar manner as were analyzed previously. Despite the increase in the number of decelerators/parachutes under Alternative 1 testing activities, entanglement of leatherback sea turtles is unlikely because of (1) the low densities of leatherback sea turtles present in the Offshore Area, (2) the unlikely event of a sea turtle being at the exact point where the decelerator/parachute lands, and (3) the negative buoyancy of decelerator/parachute constituents (reducing the probability of contact with sea turtles near the surface). Exposure to decelerators and parachutes is not expected to result in population-level impacts for leatherback sea turtles. Activities involving decelerators and parachutes are not expected to yield any behavioral changes or lasting effects on the survival, growth, recruitment, or reproduction of prey species at the population level.

Pursuant to the ESA, the use of decelerators/parachutes during testing activities under Alternative 1 may affect the ESA-listed leatherback sea turtle. The Navy has consulted with NMFS as required by section 7(a)(2) of the ES on the use of decelerators/parachutes. These activities would have no effect on designated critical habitat.

3.5.2.5.2.2 Impacts from Decelerators/Parachutes Under Alternative 2

Impacts from Decelerators/Parachutes Under Alternative 2 for Training Activities

Under Alternative 2, the number of decelerators/parachutes that would be expended during training activities in the Offshore Area is generally consistent with the number proposed for use in the 2015 NWTT Final EIS/OEIS. As shown in Table 3.0-20, the expenditure of all size decelerators/parachutes in the Offshore Area is proposed to increase slightly (increase of 466 small decelerators and parachutes, with no increases in the number of medium-size decelerators/parachutes or large parachutes). Compared to Alternative 1, Alternative 2 training activities would expend in the Offshore Area 40 additional small decelerators/parachutes, 20 additional medium decelerators/parachutes, and 47 additional large parachutes. The activities that expend decelerators/parachutes would generally occur in the same locations and in a similar manner as were analyzed previously. Because the number and locations of these decelerators/parachutes is similar to those analyzed in the 2015 NWTT Final EIS/OEIS, the impacts to leatherback sea turtles would be expected to be the same as those analyzed above under Alternative 1 training activities.

Pursuant to the ESA, the use of decelerators/parachutes during training activities under Alternative 2 may affect the ESA-listed leatherback sea turtle and would have no effect on designated critical habitat.

Impacts from Decelerators/Parachutes Under Alternative 2 for Testing Activities

Under Alternative 2, the number of decelerators/parachutes that would be expended during testing activities in the Offshore Area would increase (see Table 3.0-20) compared to the number proposed for use in the 2015 NWTT Final EIS/OEIS. Compared to Alternative 1, Alternative 2 testing activities would expend in the Offshore Area the same number of small decelerators/parachutes, with no medium-size decelerators/parachutes or large parachutes expended. The activities that expend decelerators/parachutes would generally occur in the same locations and in a similar manner as were analyzed previously. Because the number and locations of these decelerators/parachutes is similar to those analyzed in the 2015 NWTT Final EIS/OEIS, the impacts to leatherback sea turtles would be expected to be the same as those analyzed above under Alternative 1 testing activities.

Pursuant to the ESA, the use of decelerators/parachutes during testing activities under Alternative 2 may affect the ESA-listed leatherback sea turtle and would have no effect on designated critical habitat.

3.5.2.5.2.3 Impacts from Decelerators/Parachutes Under the No Action Alternative

Under the No Action Alternative, proposed training and testing activities would not occur. Entanglement stressors as listed above would not be introduced into the marine environment. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

Discontinuing the training and testing activities would result in fewer entanglement stressors within the marine environment where Navy training and testing activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would remove the potential for impacts from decelerators/parachutes on individual leatherback sea turtles, but would not measurably improve the status of leatherback sea turtle populations. Similarly, there would not be any measurable change in the PCEs under the No Action Alternative for leatherback critical habitat.

3.5.2.6 Ingestion Stressors

The ingestions stressors that may impact leatherback sea turtles include military expended materials from munitions (non-explosive practice munitions and fragments from high-explosives) and military expended materials – other than munitions (fragments from targets, chaff and flare components, and decelerators/parachutes). Larger non-explosive practice munitions (such as bombs and large-caliber munitions) are not considered ingestible by sea turtles, and are therefore not discussed as a potential stressor for sea turtles. Biodegradable polymer is a new stressor not previously analyzed in other resources sections of this Supplemental, but would only be used in the Inland Waters portion of the Study Area. Because leatherback sea turtles do not occur in inland waters, leatherback sea turtles would not be at risk of ingesting biodegradable polymers and are therefore not discussed further as a potential stressor for sea turtles.

3.5.2.6.1 Impacts from Military Expended Materials – Munitions

Ingestion impacts from military expended materials – munitions were analyzed in the 2015 NWTT Final EIS/OEIS and are discussed in this Supplemental in Section 3.0.3.6 (Ingestion Stressors). Since the 2015 NWTT Final EIS/OEIS, there has been no new or emergent science that would change in any way the analysis of military expended materials – munitions as ingestion stressors as discussed in the 2015 analyses. There have been no known instances of ingestion of military expended materials by any sea turtles prior to or since the 2015 NWTT Final EIS/OEIS.

3.5.2.6.1.1 Impacts from Military Expended Materials – Munitions Under Alternative 1

Impacts from Military Expended Materials – Munitions Under Alternative 1 for Training Activities

Under Alternative 1 and as presented in Section 3.0 (Tables 3.0-14 and 3.0-16), training use of military expended materials – munitions would decrease in comparison to ongoing activities and as discussed in the 2015 NWTT Final EIS/OEIS. When the amounts of military expended materials from munitions are combined, the number of items proposed to be expended under Alternative 1 decreases from ongoing activities. The activities that expend military materials would occur in the same locations and in a similar manner as were analyzed previously. Therefore, the impacts on leatherback sea turtles would be expected to be the same.

While training use of military expended material would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015; National Oceanic and Atmospheric Administration, 2015a) would not change. NMFS determined that the likelihood of a sea turtle ingesting expended materials was so low as to be discountable and therefore was not likely to adversely affect leatherback sea turtles. Further, jellyfish, the sea turtle's preferred prey, are filter feeders and would not ingest expended materials. Thus, the critical habitat PCEs would not be impacted from expended materials. Given that, under Alternative 1, the use of military expended materials – munitions has decreased in comparison to the 2015 analyses, impacts on sea turtles from military expended materials – munitions as ingestion stressors are not expected.

Pursuant to the ESA, the use of munitions during training activities, as described under Alternative 1, may affect ESA-listed leatherback sea turtles. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA on activities that expend munitions. These activities would have no effect on designated critical habitat.

Impacts from Military Expended Materials – Munitions Under Alternative 1 for Testing Activities

Under Alternative 1 and as presented in Section 3.0 (Tables 3.0-14 and 3.0-17), testing use of military expended materials – munitions would increase in comparison to ongoing activities and as discussed in the 2015 NWTT Final EIS/OEIS. When considering materials of ingestible size for sea turtles, the number of items proposed to be expended under Alternative 1 is less than ongoing testing activities analyzed in the 2015 NWTT Final EIS/OEIS. While testing use of military expended material would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015; National Oceanic and Atmospheric Administration, 2015a) would not change. NMFS determined that the likelihood of leatherback sea turtles ingesting expended materials was so low as to be discountable and therefore was not likely to adversely affect ESA-listed species. Further, jellyfish, the sea turtle's preferred prey, are filter feeders and would not ingest expended materials. Thus, the critical habitat PCEs would not be impacted from expended materials.

Pursuant to the ESA, the use of munitions during testing activities, as described under Alternative 1, may affect ESA-listed leatherback sea turtles. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA on activities that expend munitions. These activities would have no effect on designated critical habitat.

3.5.2.6.1.2 Impacts from Military Expended Materials – Munitions Under Alternative 2

Impacts from Military Expended Materials – Munitions Under Alternative 2 for Training Activities

Under Alternative 2, the number of military expended materials – munitions that would be used during training activities is generally consistent with the number proposed for use in the 2015 NWTT Final EIS/OEIS (Table 3.0-14 and Table 3.0-16). When the amounts of military expended materials from munitions are combined, the number of items proposed to be expended under Alternative 2 increases from ongoing activities compared to what was analyzed in the 2015 NWTT Final EIS/OEIS and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015; National Oceanic and Atmospheric Administration, 2015a), and compared to Alternative 1. While training use of military expended material would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015; National Oceanic and Atmospheric Administration, 2015a) would not change. NMFS determined that the likelihood of leatherback sea turtles ingesting expended materials was so low as to be discountable and therefore was not likely to adversely affect ESA-listed species. Further, jellyfish, the sea turtle's preferred prey, are filter feeders and would not ingest expended materials. Thus, the critical habitat PCEs would not be impacted from expended materials. As with Alternative 1, impacts from ingestion of military expended materials – munitions under Alternative 2 for training activities are not expected.

Pursuant to the ESA, the use of munitions during training activities, as described under Alternative 2, may affect the ESA-listed leatherback sea turtle, but would have no effect on designated critical habitat.

Impacts from Military Expended Materials – Munitions Under Alternative 2 for Testing Activities

Under Alternative 2 and as presented in Section 3.0 (Introduction, Tables 3.0-14 and 3.0-16), testing use of military expended materials – munitions would increase in comparison to ongoing activities and are the same as under Alternative 1 in this Supplemental. While testing use of military expended materials – other than munitions would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015; National Oceanic and Atmospheric Administration, 2015a) would not change. NMFS determined that the likelihood of leatherback sea turtles ingesting expended materials was so low as to be discountable and therefore was not likely to adversely affect ESA-listed species. Further, jellyfish, the sea turtle's preferred prey, are filter feeders and would not ingest expended materials. Thus, the critical habitat PCEs would not be impacted from military expended materials – munitions. As with Alternative 1, impacts from ingestion of military expended materials – munitions under Alternative 2 for testing activities are not expected.

Pursuant to the ESA, the use of munitions during testing activities, as described under Alternative 2, may affect the ESA-listed leatherback sea turtle, but would have no effect on designated critical habitat.

3.5.2.6.1.3 Impacts from Military Expended Materials – Munitions Under the No Action Alternative

Under the No Action Alternative, proposed training and testing activities would not occur. Ingestion stressors as listed above would not be introduced into the marine environment. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

Discontinuing the training and testing activities would result in fewer ingestion stressors within the marine environment where Navy training and testing activities have historically been conducted.

Therefore, discontinuing training and testing activities under the No Action Alternative would remove the potential for impacts from military expended materials on individual leatherback sea turtles, but would not measurably improve the status of leatherback sea turtle populations. Similarly, there would not be any measurable change in the PCEs under the No Action Alternative for leatherback critical habitat.

3.5.2.6.2 Impacts from Military Expended Materials – Other than Munitions

3.5.2.6.2.1 Impacts from Military Expended Materials – Other than Munitions Under Alternative 1

Impacts from Military Expended Materials – Other than Munitions Under Alternative 1 for Training Activities

Under Alternative 1, the number of military expended materials – other than munitions that would be used during training activities is generally consistent with the number proposed for use in the 2015 NWTT Final EIS/OEIS (Table 3.0-17, Table 3.0-20, and Table 3.0-22). When the amounts of military expended materials – other than munitions (fragments from targets, chaff and flare components, and decelerators/parachutes) are combined, the number of items proposed to be expended under Alternative 1 increases slightly from ongoing activities.

While training use of military expended material – other than munitions would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015; National Oceanic and Atmospheric Administration, 2015a) would not change. NMFS determined that the likelihood of leatherback sea turtles ingesting expended materials was so low as to be discountable and therefore was not likely to adversely affect ESA-listed species. Further, jellyfish, the sea turtle's preferred prey, are filter feeders and would not ingest expended materials. Thus, the critical habitat PCEs would not be impacted from expended materials – other than munitions.

Pursuant to the ESA, the use of military expended materials – other than munitions during training activities, as described under Alternative 1, may affect the ESA-listed leatherback sea turtle. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA on the use of military expended materials – other than munitions. These activities would have no effect on designated critical habitat.

Impacts from Military Expended Materials – Other than Munitions Under Alternative 1 for Testing Activities

Under Alternative 1, the number of military expended materials – other than munitions that would be used during testing activities increases compared to the number proposed for use in the 2015 NWTT Final EIS/OEIS (Table 3.0-17, Table 3.0-20, Table 3.0-21, and Table 3.0-22).

While testing use of military expended material – other than munitions would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015; National Oceanic and Atmospheric Administration, 2015a) would not change. NMFS determined that the likelihood of leatherback sea turtles ingesting expended materials was so low as to be discountable and therefore was not likely to adversely affect ESA-listed species. Further, jellyfish, the sea turtle's preferred prey, are filter feeders and would not ingest expended materials. Thus, the critical habitat PCEs would not be impacted from military expended materials – other than munitions. Therefore, impacts under Alternative 1 testing activities as ingestion stressors from the use of military expended materials – other than munitions are not expected.

Pursuant to the ESA, the use of military expended materials – other than munitions during testing activities, as described under Alternative 1, may affect the ESA-listed leatherback sea turtle. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA on the use of military expended materials – other than munitions. These activities would have no effect on designated critical habitat.

3.5.2.6.2.2 Impacts from Military Expended Materials – Other than Munitions Under Alternative 2

Impacts from Military Expended Materials – Other than Munitions Under Alternative 2 for Training Activities

Under Alternative 2 and as presented in Section 3.0 (Introduction, Tables 3.0-15, 3.0-17, 3.0-20, 3.0-21, and 3.0-22), training use of military expended materials – other than munitions would slightly increase in comparison to ongoing activities and Alternative 1. While training use of military expended material would change under this Supplemental, the analysis presented in Section 3.5.3.5 (Ingestion Stressors) in the 2015 NWTT Final EIS/OEIS and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015; National Oceanic and Atmospheric Administration, 2015a) would not change. NMFS determined that the likelihood of a leatherback sea turtle ingesting expended materials was so low as to be discountable and therefore was not likely to adversely affect the leatherback sea turtle. Further, jellyfish, the sea turtle's preferred prey, are filter feeders and would not ingest expended materials. Thus, the critical habitat PCEs would not be impacted from expended materials – other than munitions. Impacts on sea turtles from military expended materials – other than munitions as ingestion stressors are not expected.

Pursuant to the ESA, the use of military expended materials – other than munitions during training activities, as described under Alternative 2, may affect the ESA-listed leatherback sea turtle, but would have no effect on designated critical habitat.

Impacts from Military Expended Materials – Other than Munitions Under Alternative 2 for Testing Activities

Under Alternative 2 and as presented in Section 3.0 (Introduction, Tables 3.0-15, 3.0-17, 3.0-20, 3.0-21, and 3.0 22), testing use of military expended materials – other than munitions would increase in comparison to ongoing activities and would increase compared to Alternative 1 testing activities in this Supplemental. While testing use of military expended material – other than munitions would change under this Supplemental, the analysis presented in the 2015 NWTT Final EIS/OEIS and the NMFS Biological Opinion for the 2015 NWTT Final EIS/OEIS (National Marine Fisheries Service, 2015; National Oceanic and Atmospheric Administration, 2015a) would not change. NMFS determined that the likelihood of leatherback sea turtles ingesting expended materials was so low as to be discountable and therefore was not likely to adversely affect ESA-listed species. Further, jellyfish, the sea turtle's preferred prey, are filter feeders and would not ingest expended materials. Thus, the critical habitat PCEs would not be impacted from military expended materials – other than munitions As with Alternative 1, impacts from ingestion of military expended materials – other than munitions under Alternative 2 for testing activities are not expected.

Pursuant to the ESA, the use of military expended materials – other than munitions during testing activities, as described under Alternative 2, may affect the ESA-listed leatherback sea turtle, but would have no effect on designated critical habitat.

3.5.2.6.2.3 Impacts from Military Expended Materials – Other than Munitions Under the No Action Alternative

Under the No Action Alternative, proposed training and testing activities would not occur. Ingestion stressors as listed above would not be introduced into the marine environment. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

Discontinuing the training and testing activities would result in fewer ingestion stressors within the marine environment where Navy training and testing activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would remove the potential for impacts from military expended materials on individual leatherback sea turtles, but would not measurably improve the status of leatherback sea turtle populations. Similarly, there would not be any measurable change in the PCE under the No Action Alternative for leatherback critical habitat.

3.5.2.7 Secondary Stressors

As discussed in Section 3.5.3.6 (Secondary Stressors) of the 2015 NWTT Final EIS/OEIS, secondary stressors from military training and testing activities could pose indirect impacts on sea turtles via habitat degradation or an effect on prey availability. These stressors include (1) explosives and explosives byproducts (including unexploded ordnance), (2) metals, (3) chemicals, and (4) other materials. Analyses of the potential impacts on sediments and water quality from the proposed training and testing activities are discussed in detail in Section 3.1 (Sediments and Water Quality) of the 2015 NWTT Final EIS/OEIS. The analysis of explosives, explosives byproducts, metals, and chemicals, and their potential to indirectly impact sea turtles has not appreciably changed and is presented in detail in Section 3.5.3.6 (Secondary Stressors) of the 2015 NWTT Final EIS/OEIS given the previous conclusions were not tied to the number of activities occurring but to the nature of these stressors. The findings from multiple studies subsequent to the 2015 NWTT EIS/OEIS have reinforced the previous conclusion that the relatively low solubility of most explosives and their degradation products, metals, and chemicals means that concentrations of these contaminants in the marine environment, including those associated with either high-order or low-order detonations, are relatively low and readily diluted. For example, in the Study Area the concentration of unexploded ordnance, explosion byproducts, metals, and other chemicals would never exceed that of a World War II dump site. A series of studies of a World War II dump site off Hawaii have demonstrated only minimal concentrations of degradation products were detected in the adjacent sediments and that there was no detectable uptake in sampled organisms living on or in proximity to the site (Briggs et al., 2016; Edwards et al., 2016; Hawaii Undersea Military Munitions Assessment, 2010; Kelley et al., 2016; Koide et al., 2016). It has also been documented that the degradation products of Royal Demolition Explosive are not toxic to marine organisms at realistic exposure levels (Rosen & Lotufo, 2010). Any remnant undetonated components from explosives such as TNT, royal demolition explosive, and high-melting explosive experience rapid biological and photochemical degradation in marine systems (Cruz-Uribe et al., 2007; Juhasz & Naidu, 2007; Pavlostathis & Jackson, 2002; Singh et al., 2009; Walker et al., 2006). As another example, the Canadian Forces Maritime Experimental and Test Ranges near Nanoose, British Columbia, began operating in 1965 conducting test events for both U.S. and Canadian forces that included many of the same test events that are conducted in the NWTT Study Area. Environmental analyses of the impacts from years of testing at Nanoose were documented in 1996 and 2005 (Environmental Science Advisory Committee, 2005). These analyses concluded the Navy test activities, "…had limited and perhaps negligible effects on the natural environment" (Briggs et al., 2016; Edwards et al., 2016; Environmental Science Advisory Committee, 2005; Kelley et al., 2016). Based on these and other similar applicable findings from multiple Navy ranges as discussed in detail in Section 3.1 (Sediments and Water Quality) of this Supplemental, indirect impacts on sea turtles from the training and testing activities in the NWTT Study Area would be negligible and would have no long-term effect on habitat or prey.

Pursuant to the ESA, secondary stressors resulting from training and testing activities as described under the Alternative 1 and Alternative 2 may affect, leatherback sea turtles, and would have no effect on designated critical habitat. The Navy has consulted with NMFS as required by section 7(a)(2) of the ESA for secondary stressors under Alternative 1.

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